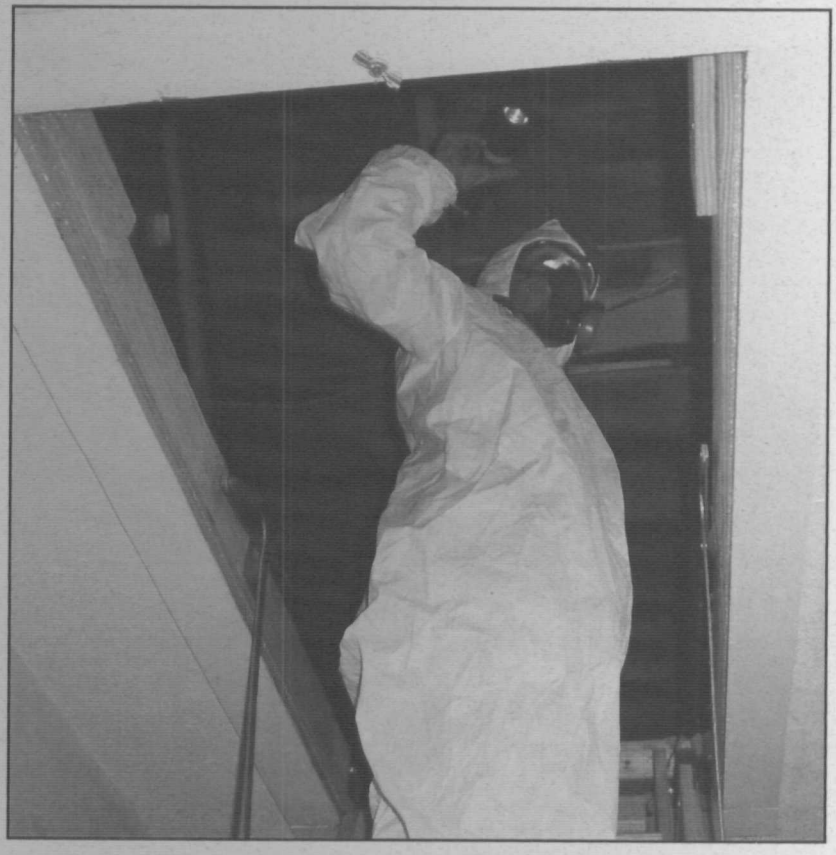
Libby Asbestos Site, Operable Unit 4
Libby, Montana

Final Sampling and Analysis Plan
Remedial Investigation
Contaminant Screening Study
Revision 1

May 2003



Sampling and Analysis Plan

Response Action Contract
for Remedial, Enforcement Oversight, and Non-Time
Critical Removal Activities at Sites of Release or
Threatened Release of Hazardous Substances
in EPA Region VIII

U.S. EPA Contract No. 68-W5-0022

Final Sampling and Analysis Plan, Remedial Investigation, Contaminant Screening Study, Revision 1, Libby Asbestos Site, Operable Unit 4

May 16, 2003

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Contents

Acronyms

AHERA	Asbestos Hazard Emergency Response Act
AIFF	additional information field form
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
BD	building location identification number
BIFF	background information field form
CAG	community advisory group
CAR	corrective action request
CDM	CDM Federal Programs Corporation
CIC	community involvement coordinator
cm^2	centimeter squared
COC	chain-of-custody
CSF	close support facility
CSS	contaminant screening study
DI	deionized water
DQOs	data quality objectives
eCOC	electronic chain-of-custody
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ERB	Emergency Response Branch
FAQ	frequently asked questions
FSDS	field sample data sheet
FSP	field sampling plan
g	gram
GIS	geographic information system
GLP	good laboratory practices
GPS	global positioning system
Grace	W.R. Grace
HASP	health and safety plan
HDPE	high-density polyethylene
HSO	health and safety officer
ID	identification
IDW	investigation-derived waste
IFF	information field form
in.	inches
KNF	Kootenai National Forest
L	liter
LA	Libby amphibole
LCS	laboratory control sample
MCE	mixed cellulose ester
MDEQ	Montana Department of Environmental Quality
mi^2	miles squared
mm	millimeter
NIOSH	National Institute of Occupational Safety and Health

NIST	National Institute of Standards and Technology
NPL	National Priorities List
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
OU	operable unit
PLM	polarized light microscopy
PM	project manager
PPE	personal protective equipment
QA	quality assurance
QAC	quality assurance coordinator
QAM	quality assurance manager
QAPP	quality assurance project plan
QC	quality control
QMP	quality management plan
QP	quality procedure
RAC	Response Action Contract
RI	remedial investigation
RPD	relative percent difference
RPM	remedial project manager
S/cm^2	structures per centimeter squared
SAP	sampling and analysis plan
SOP	standard operating procedure
SP	sample point location identification number
SRC	Syracuse Research Corporation
TEM	transmission electron microscopy
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VCI	vermiculite containing insulation
Volpe Center	John A. Volpe National Transportation Systems Center
Zonolite	Universal Zonolite Insulation Company
°F	degrees Fahrenheit

Section 1
Introduction

This document serves as Revision 1 to the sampling and analysis plan (SAP) for the contaminant screening study (CSS) as part of the remedial investigation (RI) activities for the Libby Asbestos Site Operable Unit (OU) 4 under the Response Action Contract (RAC). This SAP outlines the support that CDM Federal Programs Corporation (CDM) provided to the U.S. Environmental Protection Agency (EPA) under Work Assignment 116-RIRI-08BC during 2002 activities and will continue to provide under Work Assignment 137-RIRI-08BC during 2003 activities.

This section provides a general explanation of the purpose of the CSS and background information related to the initiation of the CSS and project organization. An expanded site background is provided in Section 2.

Previous sampling investigations at the Libby Asbestos Site include the Phase I and Phase II sampling efforts. The Phase I sampling program, initiated in early 2002, was designed as a rapid pilot-scale investigation to obtain information on airborne asbestos levels in Libby in order to judge whether a time-critical intervention was needed to protect public health, obtain data on asbestos levels in potential source materials, and identify the most appropriate analytical methods to screen and quantify asbestos in source materials.

Results of initial Phase I sampling prompted removal actions at various sites in and around Libby; the screening and export plants, the Flyway, KDC Bluffs, Plummer Elementary, Libby High School, Libby Middle School, and several residential and commercial properties. Removal actions were completed in 2002 at the screening and export plants, as well as various residential and commercial properties. These removal actions are designed to remove major sources of Libby amphibole (LA) in and around the City of Libby. Restoration activities will continue at the former screening plant site in 2003.

The Phase II sampling investigation began in March 2001 and was designed to collect systematic data on asbestos levels in air and other media in Libby to allow a reliable evaluation of current human exposure and health risk from asbestos, as well as an identification of sources of unacceptable levels of asbestos in air. A summary of the findings (EPA 2001a) of the Phase I and II studies is presented below:

- Asbestos occurs in ore and processed vermiculite obtained from the mine site located outside the city of Libby.
- Asbestos fibers of the type that occur in vermiculite ore from the mine site are hazardous to humans when inhaled.
- Asbestos material fibers that are characteristic of those that occur in materials from the Libby mine are present in a variety of different source materials at residential and commercial locations in and around the community of Libby. Outdoor source

materials include yard soil, garden soil, driveway material, and assorted mine waste materials while indoor source materials include dust and Libby vermiculite attic insulations.

- Disturbance of asbestos-contaminated source materials can result in exposure to respirable asbestos fibers in air.

- The concentrations of fibers in air generated by disturbance of source materials may exceed the Occupational Safety and Health Administrations (OSHA) standards for acceptable occupational exposures, and estimated excess cancer risks can exceed EPA's typical risk range by an order of magnitude or more.

The results of the Phase I and II investigations show that LA source materials, when disturbed, release significant amounts of respirable LA (EPA 2001a). LA sources may include vermiculite containing insulation (VCI), vermiculite products and waste, and soils contaminated with greater than 1 percent LA.

LA-containing vermiculite products have been used randomly at unknown properties in the past, and, as a result, EPA has determined that each property in the Libby Valley requires screening for potential sources of LA. However, as a result of the size of the site and the number of properties that need to be evaluated, emphasis needed to be placed on an approach that minimized sampling and analysis to identify areas requiring remediation. In addition, quantitative rules for identifying all sources of potential concern are not yet developed and depend on further development of analytical methods and site-specific risk assessment. Therefore, the CSS was designed to use a combination of visual inspections, verbal interviews, and outdoor soil sampling to screen for the presence or absence of potential sources of LA in areas where exposure is most likely to occur.

CSS activities were initiated in May 2002, and the results of the 2002 investigation are presented in the CSS interim results report (CDM 2003a). Due to the large number of properties in the Libby study area, all properties were not visited during the 2002 investigation. Therefore, CSS activities will continue into 2003 following the procedures detailed in this revised SAP. This revision implements all modifications made to the CSS SAP during the 2002 CSS activities and provides current information on soil sample analysis methods and data validation criteria established for soil samples analyzed for asbestos. The procedures detailed in this SAP revision will be conducted concurrently with the RI activities detailed in the RI SAP (CDM 2003b). Details of this concurrent investigation are in the RI SAP.

This SAP is comprised of a field sampling plan (FSP) and a QAPP specific to the CSS. The purpose of this FSP is to provide guidance to ensure that all environmentally related data collection procedures and measurements are scientifically sound and of known, acceptable, and documented quality and that they are conducted in accordance with the requirements of the project. The following sections and appendices are included in this SAP:

Section 1	Introduction
Section 2	Site Background
Section 3	Data Quality Objectives (DQOs)
Section 4	Sampling Program, Rationale, and Locations
Section 5	Field Activity Methods and Procedures
Section 6	Laboratory Analysis and Procedures
Section 7	Quality Assurance (QA)/Quality Control (QC) Program
Section 8	References
Appendix A	Syracuse Research Corporation (SRC) Technical Memorandums
Appendix B	Site Health and Safety Plan (HASP)
Appendix C	CDM Technical Standard Operating Procedures (SOPs) and Site-Specific Guidance Documents
Appendix D	Record of Deviation/Request for Modification Form
Appendix E	Volpe Paperwork Flow Process
Appendix F	Laboratory Training Outline
Appendix G	American Society for Testing and Materials (ASTM) Method D5755-95

1.1 Objectives

The primary objective of this investigation is to determine the presence or absence of potential LA sources at each property within the study area. There are several secondary objectives including:

- Identification of properties that will likely require remediation
- Identification of properties that will require further investigation
- Quantification of relative LA abundance in soils
- Identification of characteristics of properties that may increase chance of exposure to LA
- Identification of characteristics of properties that may aid in development of remedial decisions
- Determination of spatial trends

The CSS results will generate data that will aid in future cleanup decisions on a property-by-property basis. Additionally, this information may be used in future risk-based investigation.

1.2 Project Schedule and Deliverables

Fieldwork to continue the CSS is expected to begin on or about May 19, 2003 and continue until October 2003. See the project work plan (CDM 2003c) for the schedule of additional deliverables. Resulting project deliverables will include a section

regarding adherence to this SAP, any deviations that occurred, and any resulting corrective action taken.

1.3 Project Organization

The management structure for the 2003 CSS investigation differs slightly from the structure presented in the original CSS SAP. This change is due primarily to EPA working directly with CDM, versus using the U.S. Department of Transportation Volpe Center (Volpe).

CSS responsibilities for EPA and CDM's CSS project team are described in this section. The project organization chart is presented in Figure 1-1.

1.3.1 EPA Management

The EPA remedial project manager (RPM), Mr. Jim Christiansen, is CDM's primary contact for coordinating CSS work at the Libby Asbestos Site. Mr. Christiansen, as RPM, is responsible for the management and coordination of the following activities:

- Defining the scope of the CSS
- Defining data quality objectives
- Reviewing all project deliverables
- Maintaining communications with the CDM CSS project manager for updates on the status of the CSS activities

1.3.2 CDM Management

The CDM management team will be comprised of the following positions: Libby project manager (PM), CSS PM, onsite manager, field team leader, data quality assessment coordinator, quality assurance manager (QAM), field health and safety officer, and QA coordinator (QAC).

1.3.2.1 CDM Project Manager

The CDM PM for overall work at the Libby Asbestos Site is Tim Wall. Mr. Wall, as PM, is responsible for the overall management and coordination of the following activities:

- Maintaining communication with Volpe regarding the overall status of the Libby Asbestos Project
- Preparing status reports for Volpe
- Supervising production and review of deliverables for Volpe
- Tracking overall budgets and schedules

- If applicable, notifying the responsible QA staff immediately of significant problems affecting the quality of data or the ability to meet project objectives
- Procuring laboratory subcontracts

1.3.2.2 CSS Project Manager

The CSS PM is Jeff Montera. Mr. Montera is EPA's primary contact for coordinating CSS work at the Libby Asbestos Site. Mr. Montera, as the CSS PM, is responsible for the management and coordination of the following activities:

- Maintaining communication with EPA regarding the status of the CSS
- Tracking budgets and preparing status reports for EPA
- Supervising production and review of deliverables for EPA
- Maintaining communication with CDM's Libby project manager Tim Wall
- If applicable, notifying the responsible QA staff immediately of significant problems affecting the quality of data or the ability to meet project objectives
- Incorporating and informing EPA and Volpe of changes in the work plan, SAP, HASP, QAPP, and/or other project documents associated with the CSS

1.3.2.3 Onsite Manager

The CDM onsite manger is David Schroeder. Mr. Schroeder, as the onsite manager, is responsible for the management and coordination of the following activities:

- Maintaining communication with Mr. Wall, Mr. Montera, and the onsite representative from Volpe concerning the daily activities of the CSS
- Coordinating daily work activities
- Scheduling personnel and material resources needed to complete the CSS
- If necessary, identifying problems and resolving difficulties in consultation with EPA, Volpe, and CDM staff
- Ensuring field aspects of the investigation, including this QAPP, SAP, and other project documents, are implemented by the CSS task leader
- Organizing and conducting daily meetings with onsite personnel
- Implementing and documenting corrective action procedures at the team level
- Providing communication between the sampling team and project management

1.3.2.4 Field Team Leader

The CDM field team leader is Ms. Dee Warren. Ms. Warren, as the field team leader, is responsible for the management and coordination of the following activities:

- Ensuring that all sample team members are trained in proper sample collection and field documentation as described in this SAP
- Ensuring that sampling is conducted in accordance with pertinent CDM SOPs and that the quantity and location of the samples meet the requirements of this SAP
- Maintaining proper supplies necessary for each sampling team
- Performing QC checks of field team documentation and a 2 percent check of field observations and completing required documentation of the QC checks
- Coordinating with the onsite manager regarding the daily activities of the CSS
- Implementing field aspects of the investigation, including this QAPP, SAP, and other project documents

1.3.2.5 CDM Health and Safety

The CDM health and safety coordinator for the Libby Asbestos Site is responsible for the following:

- Ensuring all work will be conducted in accordance with the site-specific HASP that governs the fieldwork outlined in this SAP
- Updating the HASP and ensuring the field health and safety officer is informed of the changes

The CDM field health and safety officer for the Libby Asbestos Site is responsible for the following:

- Ensuring that the protocols specified in the HASP are carried out during field activities
- Ensuring that copies of the HASP and CDM health and safety manual are maintained at the site at all times
- Based on existing site conditions, upgrading or downgrading levels of protection in accordance with the HASP
- Conducting an initial health and safety meeting for all personnel
- Providing an overview of the HASP to all assigned field personnel and having them sign a form to indicate they understand the content of the HASP document and will adhere to its specifications

- Contacting the health and safety coordinator if any questions or issues arise during field activities

1.3.2.6 Data Quality Assessment Coordinator

The CDM data quality assessment coordinator is Ms. Cherrie Zakowski. Ms. Zakowski, as the data quality assessment coordinator, is responsible for the management and coordination of the following activities:

- Ensuring that data is being validated in a timely manner in accordance with guiding documents
- Receiving and maintaining data (electronic and hardcopy) from project laboratories
- Coordinating with Volpe database personnel with regards to uploading data validation information into the project database

1.3.2.7 Quality Assurance Coordinator

The CDM QAC is Ms. Krista Lippoldt. Ms. Lippoldt, as the QAC, is responsible for the management and coordination of the following activities:

- Directing the overall project QA program
- Reviewing and approving the project-specific documents
- Maintaining awareness of active projects and their QA/QC needs
- Consulting with the CDM QA manager, as needed, on appropriate QA/QC measures and corrective actions
- Conducting field and office audits to check on the use of appropriate QA/QC measures, if applicable
- Providing monthly written reports on QA/QC activity to the CDM QA director

The QAC reports to CDM's QA director, Mr. George DeLullo. The QA director is independent of the technical staff and reports directly to the president of CDM on QA matters. The QA director, thus, has the authority to objectively review projects and identify problems and the authority to use corporate resources as necessary to resolve any quality-related problems.

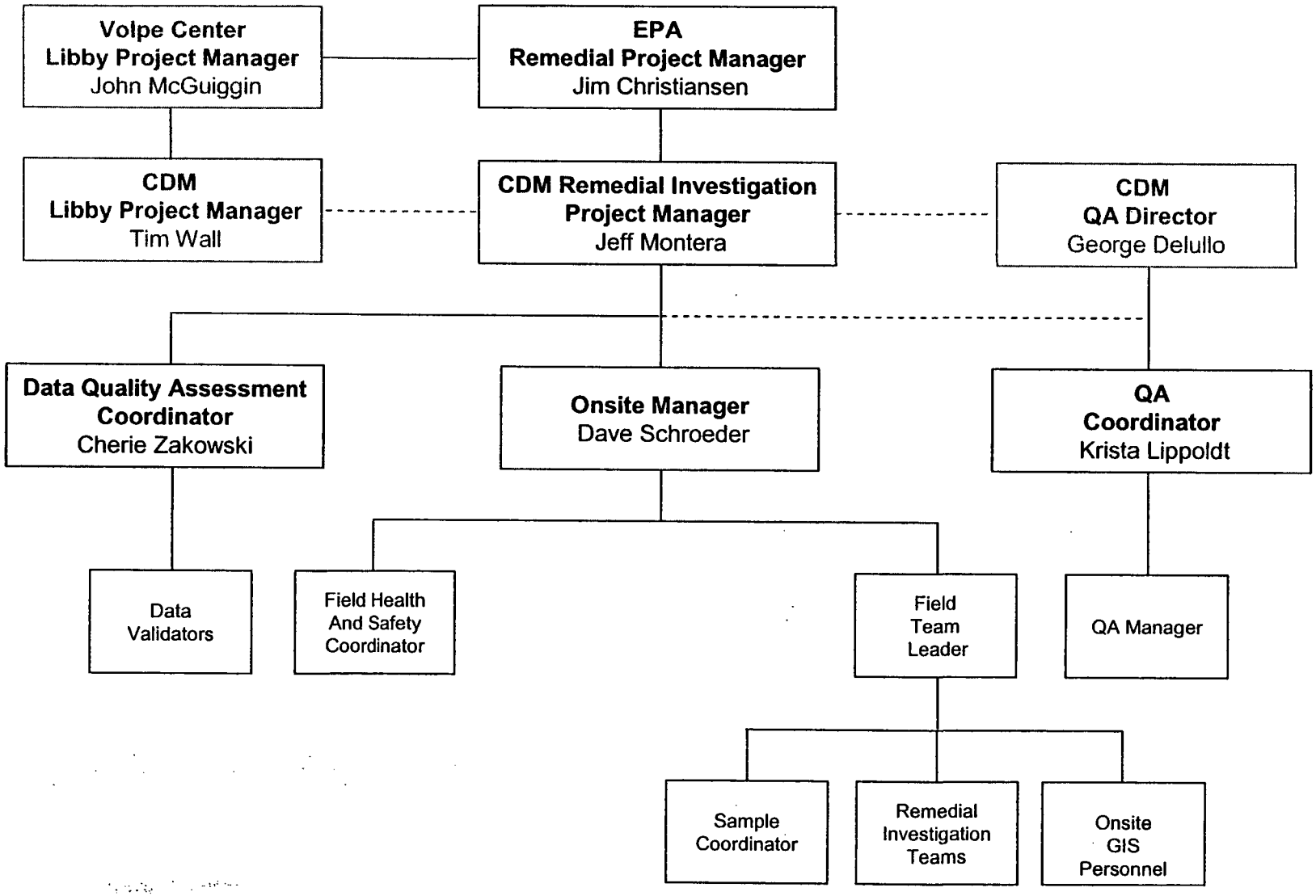
1.3.2.8 Quality Assurance Manager

The CDM QAM for the Libby Asbestos Site is responsible for the following:

- Monitoring all quality assurance/quality control (QA/QC) activities of the project (as described in Section 6)
- Identifying QA areas that need changes or improvements

- Verifying that corrective actions resulting from staff observations, QA/QC surveillances, and/or QA audits are documented and implemented
- Communicating directly with the CDM project manager and onsite manager regarding daily QA/QC issues

Figure 1-1: CSS Project Management Organization Chart



Section 2
Site Background

2.1 Site Location

The Libby Asbestos Site is located within Sections 3 and 10, T30N, R31W of the Libby Quadrangle in Lincoln County, Montana (Figure 2-1). It includes a vermiculite mine; two former vermiculite processing centers, the former screening plant and the former export plant; the road between the former screening plant and the mine site (Rainy Creek Road); and homes and other businesses, which may have become contaminated with asbestos fibers as a result of the vermiculite mining and processing conducted in and around the City of Libby (Figure 2-2).

2.2 Site History

Vermiculite was discovered 7 miles northeast of Libby, Montana in 1881 by gold miners. In the early 1920s, Mr. Edward Alley began initial mining operations on the vermiculite ore body located approximately 7 miles northeast of Libby. Full-scale operations began later that decade under the name of the Universal Zonolite Insulation Company (Zonolite). This ore body contained amphibole asbestos fibers with compositions including tremolite, actinolite, richterite, and winchite (herein referred to as LA) as defined by B.E. Leake, et al. (1997). Unlike the commercially exploited chrysotile asbestos, LA material has never been used commercially on a wide scale, and, for the mine's operating life, it was considered a byproduct of little or no value. The commercially exploited vermiculite was used in a variety of products, including insulation and construction materials, as a carrier for fertilizer and other agricultural chemicals, and as a soil conditioner.

The vermiculite ore was mined using standard strip mining techniques and conventional mining equipment. The ore was then processed in an onsite dry mill to remove waste rock and overburden material. Once processed, the ore was transported from the mine to the former screening plant, which sorted the ore into five size ranges. After the sorting process, the material was shipped to various locations across the United States, for either direct inclusion in products or for "expansion" prior to use in products. Expansion (also known as "exfoliation" or "popping") was accomplished by heating the ore, usually in a dry kiln, to approximately 2000 degrees Fahrenheit (°F). This process explosively vaporizes the water contained within the phyllosilicate structure causing the vermiculite to expand by a factor of 10 to 15. This produces the vermiculite material most commonly sold as soil conditioner for gardens and greenhouses.

In Libby, operations handling this material occurred at four main locations: the mine and mill located on Rainy Creek Road on top of Zonolite Mountain; the former screening plant and railroad loading station located at the intersection of Highway 37 and Rainy Creek Road and directly across the Kootenai River, respectively; the former expansion/export plant (the former export plant) located immediately west of Highway 37 where it crosses the Kootenai River; and at the former expansion plant located at the end of Lincoln Road, near 5th Street (Figure 2-3). The Lincoln Road

Expansion Plant went off line sometime in the early 1950s. Investigations are underway to determine the exact location of this facility.

All structures at the former screening plant have been demolished, and contaminated soils have been removed and placed in the mine. Restoration of the former screening plant is expected to be completed in 2003. Similarly, all removal actions were completed during 2002 at the former export plant site, and approximately 5,000 cubic yards of contaminated soils have been removed and placed in the mine. Removal activities have not been initiated at the mine or railroad loading station.

In 1963, the W.R. Grace Company (Grace) purchased Zonolite and continued vermiculite-mining operations in a similar fashion. In 1975, a wet milling process was added that operated in tandem with the dry mill until the dry mill was taken off line in 1985. The wet milling process was added to reduce dust generation of the milling process. Expansion operations at the former export plant ceased in Libby sometime prior to 1981 although this area was still used to bag and export milled ore until mining operations were stopped in 1990. Before the mine closed in 1990, Libby produced about 80 percent of the world's supply of vermiculite.

Since 1999, EPA Region VIII's Emergency Response Branch (ERB) has been conducting sampling and cleanup activities to address highly contaminated areas in the Libby Valley. The ERB investigation was initiated in response to media articles, which detailed extensive asbestos-related health problems in the Libby population. While at first the situation was thought limited to those with direct or indirect occupational exposures, it soon became clear that there were multiple exposure pathways and many persons with no link to mining-related activities were affected.

Typically, the amphibole asbestos contamination found in the Libby Valley comes from one or some combination of "primary" sources: vermiculite mining wastes, vermiculite ores, vermiculite processing wastes, bulk residuals from vermiculite processing, "LA-containing rocks," or Libby vermiculite attic insulation. Asbestos from these primary sources has been found in interior building dust samples and local soils, which in turn act as secondary sources. To date, the goal of ERB has been to find and identify areas with elevated levels of asbestos (the primary sources) and to remove them. ERB has conducted contaminated soil removals at the former export plant location, the former screening plant and adjacent properties, and several residential properties with asbestos source materials present. Three schools in the Libby school system have also had removals performed. Details of these operations can be found in the applicable Action Memorandums.

Future work in Libby is proceeding on two fronts. First, the removal of previously identified primary outdoor source areas continues and the removal of VCI from buildings in the Libby Valley will continue in 2003. Second, the EPA Superfund Remedial Program initiated an RI in 2002, of which the CSS is the first phase. The CSS will identify additional properties containing primary sources, which require immediate cleanup, as well as identify properties that might require further

investigation and/or remediation as final risk assessment and cleanup decisions are made.

For long-term management purposes, the Libby Asbestos Site has been divided into two OUs: Operable Unit 3 (OU3), which represents the former mine and Rainy Creek Road, and Operable Unit 4 (OU4), which represents the remainder of the Libby Valley. This FSP has been prepared to address investigative activities associated with OU4 only. Plans for the work associated with OU3 are expected in the near future.

2.3 Environmental Setting

Mean annual precipitation in Libby is 19.4 inches (in.), with 37 percent occurring between the months of November through January. In addition, 18 percent of the annual precipitation occurs during the months of May and June. The month having the highest average precipitation is January, with 2.42 in. Average ambient temperature in Libby ranges from 22.4°F in January to 67°F in July. Average annual precipitation at the mine site is estimated at 20 in. per year, and the temperature would be expected to average 3 to 5 degrees cooler due to the higher elevation relative to the City of Libby. Climatological data were obtained from the Libby 1 N.E. Ranger Station 5 miles northeast of Libby.

2.4 Contaminant of Concern

The contaminant of concern for this investigation is LA. Asbestos fibers are odorless and tasteless and vary in length, structure, and chemical composition. Fibers are microscopic and environmentally persistent. They do not evaporate, burn or dry out from heat, or erode in water. The toxicity of different types of asbestos fibers varies, but chronic and acute exposure to any one of them potentially can be fatal. While some chrysotile asbestos is likely present in the study area, it is not due to site-related contamination and is not considered a contaminant of concern. While some analytical methods provide information on all 6 regulated asbestos material plus LA, the CSS will only evaluate or assess LA. If other contaminants are discovered, the property owner will be properly advised.

The human health risks associated with asbestos fibers released in the environment include:

- Malignant mesothelioma, a cancer of the pleural or peritoneal cavity. In early stages of the disease, cancer is found in the lining of the chest cavity near the lung and heart or in the diaphragm. Mesothelioma may spread to tissue surrounding the lungs or other organs. Virtually all mesothelioma cases are attributable to asbestos exposure.

- Asbestosis, the scarring of the tissue of the lung itself from inhalation of fibers. It ranges in severity from mild impairment to disabling and eventually fatal.

- Lung cancer, any type of malignant tumor that originates in the lung itself. The exact relationship between asbestos exposure and lung cancer is not completely understood.

Color Map(s)

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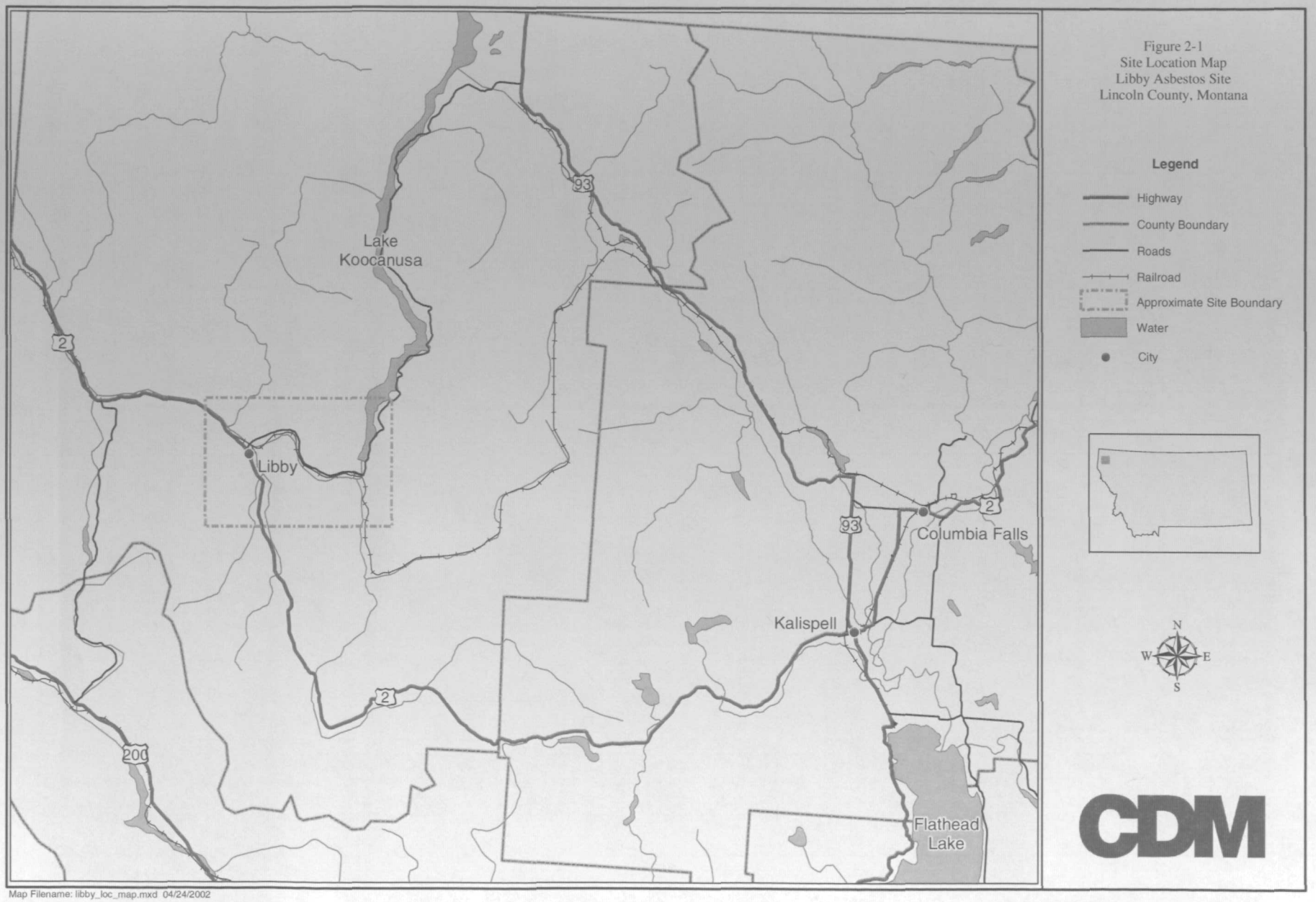

Figure 2-1
Site Location Map
Libby Asbestos Site
Lincoln County, Montana

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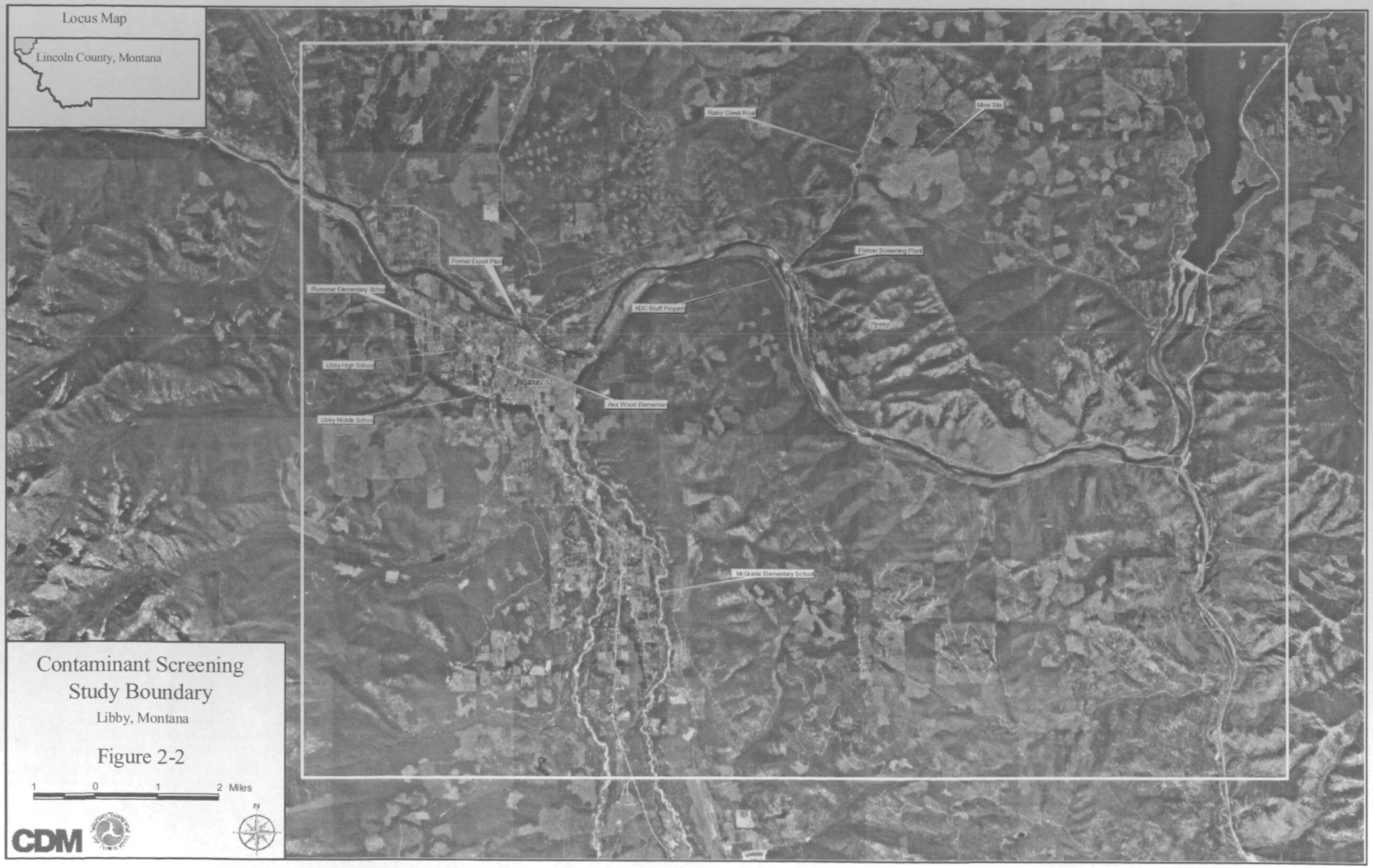
Locus Map
Lincoln County, Montana
Rainy Creek Road
Mine Site
Former Screening Plant
Former Export Plant
Rummer Elementary School
KDC Bluff Property
Flyway
Libby High School
Asa Wood Elementary
Libby Middle School
McGrade Elementary School
Contaminant Screening Study Boundary
Libby, Montana
Figure 2-2
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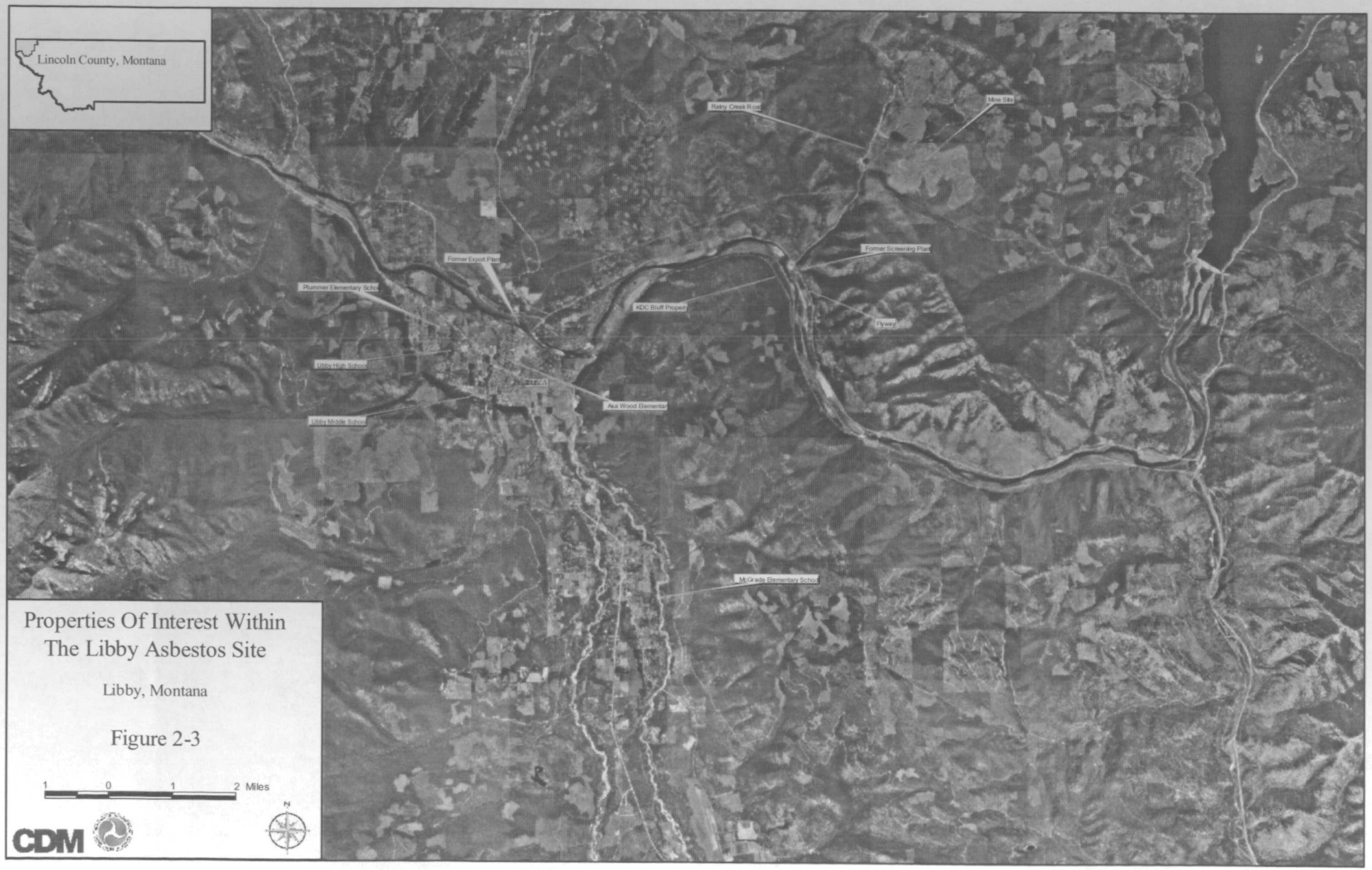
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Mine Site
Former Screening Plant
Former Export Plant
Plummer Elementary Schoo
KDC Bluff Property
Flyway
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Asa Wood Elementar
Libby Middle School
McGrade Elementary School
Properties Of Interest Within
The Libby Asbestos Site
Libby, Montana
Figure 2-3
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Section 3
Data Quality Objectives

The DQO process is a series of seven planning steps based on the scientific method that are designed to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended purpose. The goal of the DQO process is to help assure that data of sufficient quality are obtained to support remedial response decisions, reduce overall costs of data sampling and analysis activities, and accelerate project planning and implementation. The DQO process related to this CSS is presented below and includes all information as required under the seven-step process.

A vermiculite ore body was discovered 7 miles northeast of Libby, Montana. Mining of this ore body began in the early 1920s and continued until 1990. This ore body contained amphibole asbestos fibers with compositions, including tremolite, actinolite, richterite, and winchite as defined by B.E. Leake, et al. (1997) (LA). Vermiculite in processed and unprocessed forms was used throughout the City of Libby as soil amendments, fill material, insulation, and as building materials. Occupational exposure to these asbestiform minerals occurred during the mining, processing, and transportation of the ore. Non-occupational exposures occurred as family members of workers were exposed through "worker take-home" ambient air levels, and from the presence of Libby vermiculite used as soil amendments, fill material, insulation, and in other building materials. Exposure to these asbestos fibers can cause several adverse health effects, including malignant mesothelioma, asbestosis, and lung cancer (ATSDR 2001). The exposure pathways are presented in the site conceptual model (Figure 3-1). Inhalation is the only exposure route of concern for this investigation.

In 1999, EPA was alerted by a newspaper article of an abnormally high incidence of asbestos-related disease in Libby, Montana and, therefore, began an investigation an emergency response in the area (Libby Asbestos Site). To date, EPA has identified sources of LA that present an immediate danger to human health (i.e., hot spots) and have begun removal actions of these sources (EPA 2000d, EPA 2001c). However, at present, EPA does not know locations of other sources of LA at residences and commercial sites that have not been investigated. Because LA-containing vermiculite products have been used randomly at unknown properties in the past, EPA has determined that each property in the study area requires screening for potential sources of LA. A sampling program, which exhaustively measures all potential LA sources and exposures at each property in one step (e.g. extensive indoor dust sampling, transmission electron microscopy [TEM] analysis, and risk-based outdoor sampling), is both unnecessary and cost/time prohibitive. A two-step sampling program, which builds upon past EPA investigations in Libby in order to limit future analytical costs while still making sound decisions, is a more efficient approach. In this regard, the CSS was designed as the first phase of the RI. The CSS is intended to screen all properties in the study area and generally classify them as either:

1. LA is present and it is likely that no further investigation will be necessary to determine that property requires cleanup.

2. LA is or may be present, but additional sampling and investigation is required to determine if cleanup is warranted. The 2nd phase of the RI would address these properties. The 2nd phase of the RI activities are detailed in the RI SAP (CDM 2003b).

3. There is no evidence that LA is present and it is likely that no cleanup or further investigation will be required.

Within that prioritization approach, the primary objective of the CSS is to determine the presence or absence of potential LA sources at each property in the study area. In the original SAP, sources were categorized as follows.:

- Primary sources, which include VCI, other visibly identifiable vermiculite products originating from the Libby mine (stockpiles of vermiculite, LA-containing rocks, etc.), and outdoor soils without visible vermiculite that contain greater than or equal to 1 percent LA by weight. The rationale for a 1 percent action level is discussed below.

- Secondary sources, which include contaminated indoor dust and outdoor soils without visible vermiculite that contains less than 1 percent LA by weight. Some indicators for the presence of secondary indoor sources (LA-contaminated dust) are the past presence of VCI, former or current occupants were persons employed at the mine or a former processing facility, and/or former or current occupants were diagnosed with an asbestos-related disease.

This simplified approach was developed in order to find and address potential sources LA. This SAP revision continues this basic approach with some minor modifications based upon the maturation of the investigation and cleanup program. Included in these changes are some minor changes in terminology. For instance, in this revision, the media of interest (generally insulation, soil, and dust) are no longer segregated into "primary" and "secondary" categories or referred to exclusively as "sources." Rather, this document will address each media by its own name and qualities (such as VCI, soil with LA greater than 1%, or indoor dust) and does not draw distinctions between primary and secondary. Again, the rationale and implementation of the CSS program has not significantly changed, but the maturation of the overall investigation and cleanup program has allowed us to be more specific regarding cleanup criteria for each media of interest and negated the need for general categorization.

In addition, the information collected during this study will be used for the following:

- Quantification of relative LA abundance in soils

- Identification of characteristics of properties that may increase chances of exposure to LA
- Identification of characteristics of properties that may aid in the development of remedial decisions
- Determination of spatial trends
- Determination of future risk-based investigation and remedial decisions on a property by property basis

The planning team for the CSS includes Jim Christiansen (EPA RPM and decision maker), Mary Goldade (EPA project chemist), John McGuiggin (Volpe project manager), Tim Wall (CDM project manager for the Volpe), Jeff Montera (CDM RAC project manager for EPA), David Schroeder (CDM onsite manager), Dee Warren (CDM CSS field team leader), and Krista Lippoldt (CDM QAC).

The information gathered to answer the primary objective will be collected from residential and commercial properties within the study area (target population). The spatial boundaries of these properties include everything between the top of the tallest structure to 6 inches below the ground surface and within each property boundary. The temporal boundaries include the time frame from when mining activities began at the mine site through the time of visual inspection and/or sampling at a property.

The information for this study was initially collected between May 13, 2002 and November 12, 2002 and will continue to be collected during 2003 field activities between May 19 and October 31, 2003. All personnel conducting the fieldwork associated with this CSS will be from CDM. Budget and schedules related to the project are discussed in the work plan (CDM 2003c).

In order to meet the primary objective, a screening program using visual inspection, verbal interviews, and analytical results will be implemented. The following explains how each of these will be used.

- Visual inspection will be used to determine the presence or absence of VCI, vermiculite products and waste, ,and/or vermiculite present in building materials. If during visual inspection vermiculite is observed in any of these areas in any amount, they will be assumed to be present at the property. The rationale for considering visible observations of Libby vermiculite products or waste as a definitive indicator of LA content is presented in Appendix A.
- Verbal interviews will be used to identify properties that used Libby vermiculite attic insulation in the past, used vermiculite in building materials, had former or current occupants who were employed in vermiculite mining activities in Libby, and/or had former or current occupants who were diagnosed with an asbestos-

related disease. If during a verbal interview, any of these factors is identified, the potential of an LA source will be assumed.

- Analytical results of soil samples will be used to determine if sources of LA are present and if cleanup is required. The determination of cleanup actions based on soil is explained in the Response Action Work Plan (RAWP) (CDM 2003e) and summarized in Table 3-1.

A range of asbestos analytical techniques are currently being considered for this investigation to identify potential LA in soil. Methods are currently being evaluated through a performance evaluation study conducted by EPA. Once the study is complete and the results reviewed, a determination will be made regarding the appropriate analytical method for soil (ISSI 2000, SRC 2003a, and SRC 2003b).

Presence or absence of LA sources in soil is dependent on the analytical sensitivity (detection limit) for a particular analytical method, and decisions about further analysis and/or cleanup will be based upon the reported value and the method detection limit. Again, because evaluation of soil analytical methods continues, this lower level cannot be exactly defined although EPA anticipates achieving reporting limits of approximately 0.1 to 0.2%. At present, EPA has determined that soils exhibiting concentrations greater than or equal to 1% LA require cleanup. The rationale for choosing this concentration is presented below:

- Studies performed during the Phase 2 investigation demonstrate that disturbance of Libby vermiculite products or waste with any level of detectable asbestos (i.e. trace or higher) can release respirable asbestos fibers into the air, which may greatly exceed typical risk guidelines (EPA 2001a). Such releases have been documented even for materials for which bulk measurements of asbestos were non-detect by polarized light microscopy (PLM).

- Because of the potential that these materials may serve as sources for LA, EPA has determined that these materials should be cleaned up (EPA 2000d, EPA 2001c). In this regard, any detection of asbestos in bulk Libby vermiculite materials by PLM (i.e. trace) has been considered sufficient justification for action in Libby to this point.

- The concentration of asbestos in bulk materials that is detectable, but not quantifiable by PLM, (i.e., trace) is estimated to be approximately 0.5 percent by weight (i.e., one half PLM quantitation limit).

- Therefore, to remain strictly consistent with previous EPA actions regarding Libby vermiculite products or waste, concentrations of 0.5 percent or greater in soil could be considered the approximate trigger for action for the CSS.

- However, because of the uncertainty of analytical results in this range, at the present time only soil with asbestos concentrations greater than 1 percent will

spur immediate cleanup decisions (to ensure cleanup decisions are made on a "worst first" basis and to avoid making needless expenditures). Soils with concentrations less than 1 percent may be investigated further in the future.

Visible vermiculite in specific use areas will be remediated per the RAWP. Additional sampling will be required in other areas where visible vermiculite was noted (e.g., yard). This decision is based on two primary factors:

1. The amount of vermiculite in specific use area tends to be higher than in the yard, as it was often used in these areas as a soil conditioner. Such areas are most likely to contain elevated levels of LA. Generally, these areas are small, present the greatest exposure risk (people working in gardens), and can be remediated quickly. EPA has made the decision that cleaning up these areas without additional sampling will be most protective in the short term and most efficient over the long term.

2. The amount of vermiculite in the yard tended to be lower than in specific use areas (in fact it may have been a few flakes over a very large area). The yard generally presents a lesser exposure risk than specific use areas and is much larger and more difficult to remediate. EPA decided that additional sampling is required for these areas to determine if LA is present and cleanup is warranted.

For the purposes of the RI, the detection of LA at any amount is considered to verify the presence of LA. However, during the emergency response cleanup program, cleanup will only be required when certain trigger levels are exceeded (e.g. 5,000 S/cm^2 in dust or 1% LA in soil). These levels are generally well above the anticipated detection limits of dust and soil analytical methods. Although it is known that some analytical error exists, no gray area was established around the emergency response trigger levels.

The practical constraints that may interfere with the collection of accurate and complete information include, but are not limited to lack of property access, misinformation from property owner/resident, unnoticed or hidden potential LA sources, inclement weather conditions (i.e., snow-covered ground, frozen soils, overcast skies, etc.), and lack of access to attics or wall cavities. Overcast skies reduce the visibility of phyllosilicates (unexpanded vermiculite); snow prevents outdoor visual confirmation; and frozen soils limit composite soil sample homogenization.

The alternative actions that may occur at a property as a result of information gathered during the study include the following:

- Remediation of interior, which includes removal of Libby vermiculite attic insulation and cleaning

- Remediation of exterior, which includes removal of vermiculite products and waste and soils contaminated with greater than 1 percent LA

- Further indoor sampling
- Further outdoor sampling
- No further action at this time

The determination of which decision(s) is appropriate will be made following the guidance outlined in Table 3-1. These decisions are based on the following rationale:

- VCI, vermiculite products and waste, soils contaminated with greater than 1 percent LA, inherently contain high levels of LA (Appendix A).
- The levels of LA in these materials pose a risk to human health (EPA 2001a).
- The presence of VCI, vermiculite products and waste, and soils contaminated with greater than 1 percent LA also indicates that contaminated indoor dust and outdoor soil source materials that are less than 1 percent LA by weight may be present.
- Further risk-based investigation is needed to determine if media other than VCI, vermiculite products and waste, and soils contaminated with greater than 1 percent LA pose a risk to human health (e.g., indoor dust and outdoor source materials that are less than 1 percent LA by weight).
- It is necessary to identify these other media at each property in the instance that further risk-based investigation indicates that these media pose a risk to human health. If it is determined that these media do pose a risk, further action (i.e., remediation) may be taken.
- Properties that do not meet any of these triggers for action will not undergo any remediation at this time. But, these properties might require further investigation and/or remediation as final risk assessment and cleanup decisions are made.

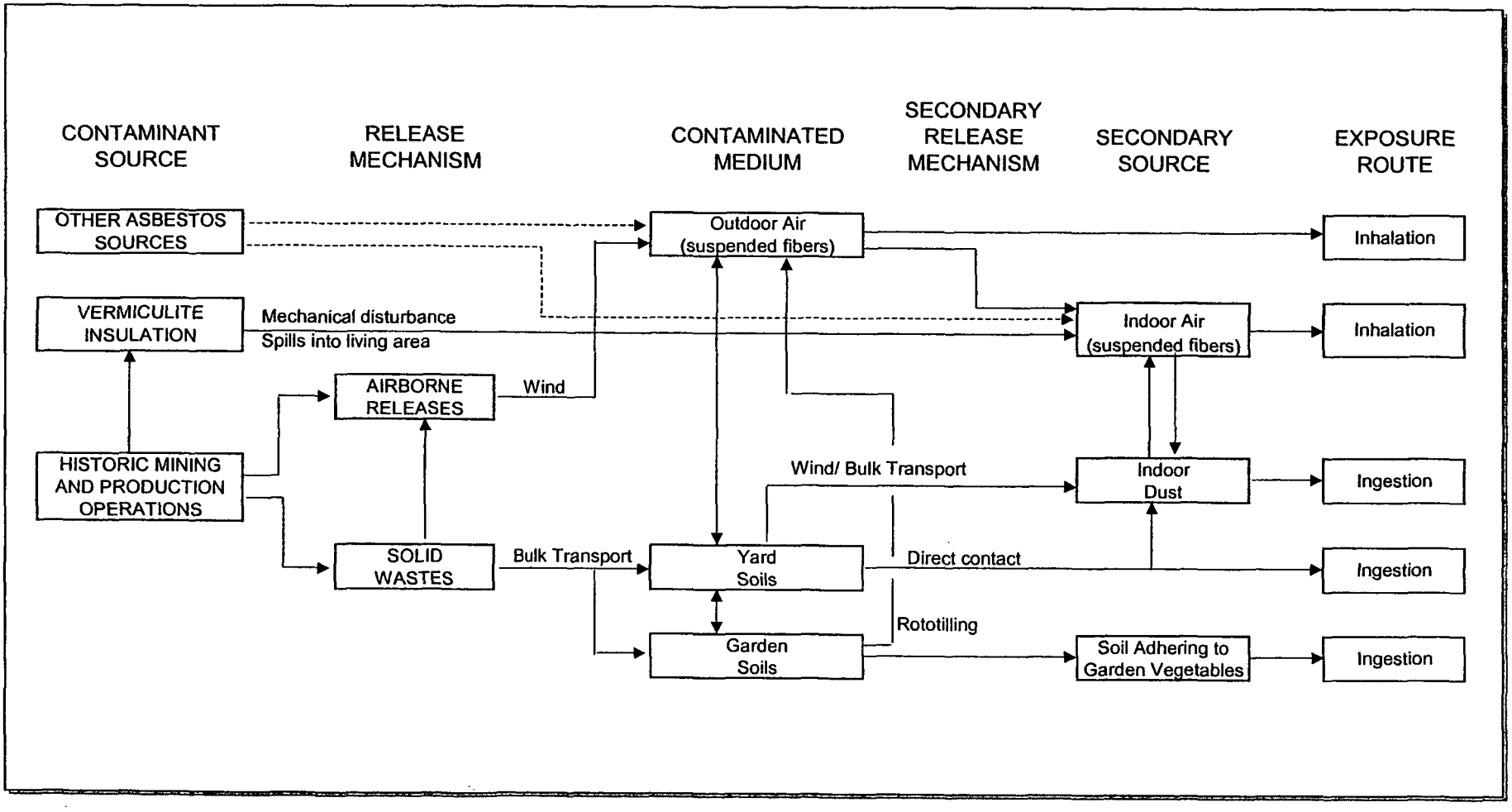
DQOs were reviewed and used to design the study/sampling process detailed in this SAP (Sections 4 and 5).

Table 3-1 Remedial and Investigation Actions Based on EPA Action Memorandum (EPA 2002) from Data Collected During 2002 CSS

Decision	Category	Location	Action Criteria	Action/Action Level
Remediation Required (1,340 properties)	**Indoor remediation required (242 properties)**	VCI in attic	▪ VCI observed	▪ Remove or isolate VCI.
			▪ Observation of VCI remnants or an attic dust sample with results are greater than or equal to 5,000 LA S/cm^2	▪ Remove or isolate VCI.
		Indoor living space	▪ Visual VCI in living space	▪ HEPA vacuum and wet wipe interior living space.
			▪ Living space dust sample results with a concentration greater than or equal to 5,000 LA S/cm^2	▪ HEPA vacuum and wet wipe interior living space.
	Outdoor remediation required (742 properties)	Specific use areas	▪ Visible vermiculite	▪ Remove area.
		Other soil areas	▪ Soil sample results with a concentration greater than or equal to 1% LA	▪ Remove area.
	Indoor and outdoor remediation required (222 properties)	Combination of above locations	▪ See triggers identified above	▪ See actions identified above.
	Indoor remediation and outdoor sampling required (40 properties)	Combination of above locations	▪ See triggers identified	▪ See actions identified above.
	Outdoor remediation and indoor sampling required (94 properties)	Combination of above locations	▪ See triggers identified	▪ See actions identified above.
Additional Information Required (709 properties)	**Indoor sampling required (569 properties)**	Indication of secondary indoor sources in living space	▪ Current or past resident employed at Libby vermiculite mine or other Libby processing facilities	▪ Collect dust samples in living space to determine if concentration is greater than or equal to 5,000 LA S/cm^2.
			▪ Current or past resident diagnosed with an asbestos-related disease	▪ Collect dust samples in living space to determine if concentration is greater than or equal to 5,000 LA S/cm^2.
			▪ VCBM is friable	▪ Collect dust samples in living space to determine if concentration is greater than or equal to 5,000 LA S/cm^2.
		VCI in attic	▪ Presence of VCI in attic not confirmed	▪ Visually inspect attic and/or collect dust samples in living space to determine if concentration is greater than or equal to 5,000 LA S/cm^2.
			▪ VCI was present in the past	▪ Collect dust samples in attic and/or living space to determine if concentration is greater than or equal to 5,000 LA S/cm^2.
	Outdoor sampling required (83 properties)	Other soil areas	▪ Vermiculite visible over large area of property	▪ Collect soil sample from area to determine if area contains 1% LA or greater.
	Indoor and outdoor sampling required (57 properties)	Combination of above locations	▪ See triggers identified above	▪ See actions identified above.
No Remediation Required (1,103 properties)	**No remediation required (1,103 properties)**	No indications of potential LA sources	▪ VCI not present in attic ▪ VCI not present in attic in past ▪ All available dust results are less than 5,000 LA S/cm^2 ▪ No visible vermiculite in specific use areas ▪ All soil sample results are less than 1 percent LA ▪ No mining history at property ▪ No asbestos-related disease history ▪ Vermiculite not used in building materials	▪ None.

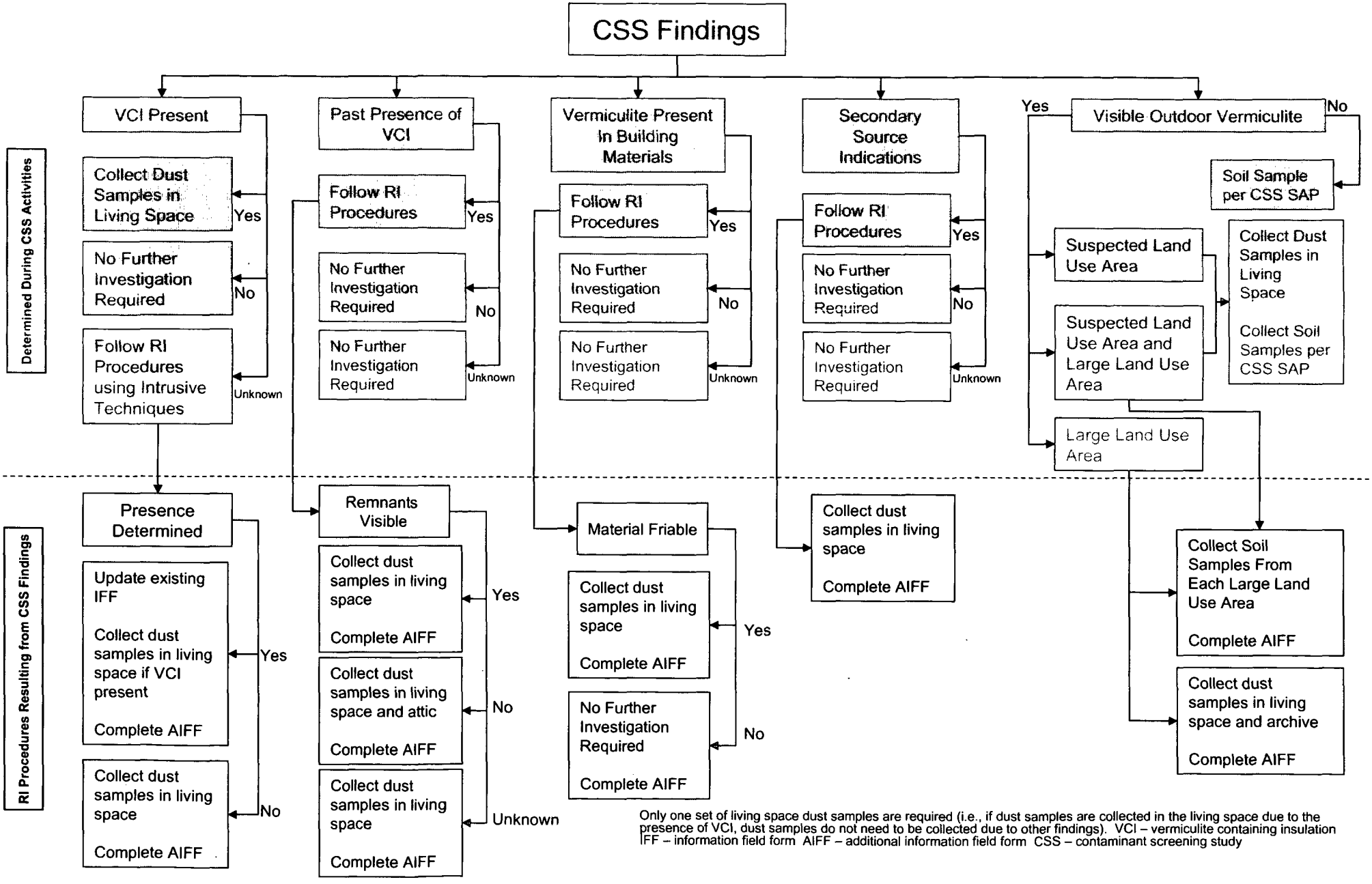
LA – Libby amphibole
S/cm^2 – structures per square centimeter
VCI – vermiculite containing insulation
VCBM – vermiculite containing building material

Figure 3-1: Conceptual Site Model



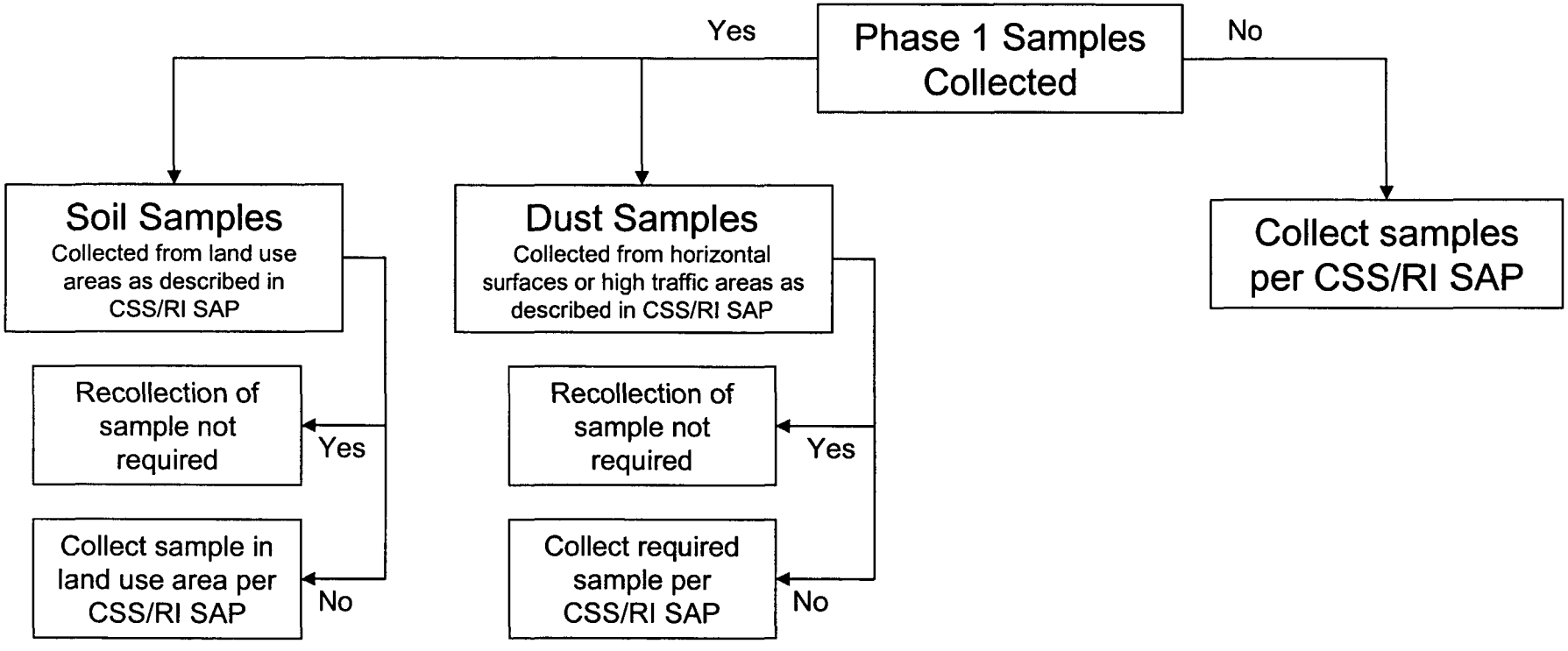
* Figure created by the Syracuse Research Group (version 7, April 2, 2002)

Figure 3-2: Relationship Between Concurrent RI Sampling and Findings of CSS Activities



Only one set of living space dust samples are required (i.e., if dust samples are collected in the living space due to the presence of VCI, dust samples do not need to be collected due to other findings). VCI – vermiculite containing insulation IFF – information field form AIFF – additional information field form CSS – contaminant screening study

Figure 3-3 Relationship Between Phase 1 Data and CSS/RI Sample Collection



Section 4
Sampling Program, Rationale, and Locations

Sections 4 and 5 comprise the FSP for the Libby RI CSS activities. This section describes the screening process and sampling for residential and commercial properties within the study area. Specific sampling methods and procedures are presented in Section 5.

4.1 Contaminant Screening Study

The CSS will use a combination of visual inspection, verbal interviews and outdoor soil, sampling to identify sources of LA within the study area. Screening and sampling will focus on areas where vermiculite products are most likely to be encountered (e.g., attic insulation, garden soil amendments) and where disturbance/exposure is most likely to occur (e.g., near-surface soils as opposed to soil at depth). Results of the investigation will be used to classify properties (or portions of properties) within the study area with the following designations:

- Property has no indication of sources of LA inside or outside. No further investigation at this time.
- Property has sources of LA and immediate cleanup activities may be conducted.
- Property does not have sources of LA, but there are indications that soil samples may have less than 1% LA or indoor dust may contain LA, or may be, present. Further investigation may be required to determine if cleanup activities are necessary.

4.2 Study Boundaries

The CSS will focus on all residential and commercial properties within the study area (Figure 2-2). Natural physiographic features have generally defined the study area, which encompasses the City of Libby and surrounding areas where LA contamination has historically been found. The total study area is approximately 192 square miles (mi^2). Areas where structures do not exist and/or where conditions indicate (e.g., vegetation predates mining activities) sources of contamination were not introduced will not be included in the CSS investigation except on a case-by-case basis after consultation with EPA. The study area boundaries may be adjusted as the extent of contamination becomes clear. Also, specific properties with unique or complex circumstances (e.g., large or many buildings) may be addressed with a modified sampling approach slightly different than the approach detailed in this SAP. An addendum to the SAP will be prepared for such cases.

4.3 Study Process

The CSS process is designed to systematically screen and sample every property within the study area and will include the following steps:

- Selecting study locations
- Public awareness and reconnaissance
- Field screening and sampling activities
- Sample analysis and data validation

Figure 4-1 represents the personnel responsible for each step of the CSS process. Figures 4-2 through 4-5 present the responsibilities of each CSS team member specific to the CSS process.

4.3.1 Selecting Study Locations

While the study will initially target the denser populated areas of the study area (e.g., City of Libby), some of the study area border properties will be simultaneously investigated to obtain data from perimeter properties. The purpose of this approach is to provide information to decision makers during the investigation as to any contamination trends that may exist (e.g., perimeter properties having less contamination). In addition, commercial properties will receive priority status, so business owners can become familiar with their situation regarding LA contamination. Approximately 20 to 25 residential and commercial properties will be screened and sampled per day.

Data collected on a daily basis (e.g., questionnaires and northing and easting coordinates) will be entered into the Libby Project Database maintained by Volpe in order to provide up-to-date tracking of properties visited and results obtained. This information will be used to evaluate progress and identify areas requiring immediate consideration for potential removal activities.

Screen Previous Data

Relevant property data (completed questionnaires and soil sample results) collected during the previous Phase I investigation will be evaluated to determine if sufficient information exists to satisfy the DQOs (Section 3). Soil samples collected from these properties during Phase I activities were analyzed by PLM and then archived. The archived sample will be submitted for additional analysis as described in Section 4.3.4. If sufficient data exists to satisfy the DQOs, then these properties will be exempt from the CSS investigation, and the existing data will be used to confirm the presence or absence of LA. If a Phase I background information field form (BIFF) was completed for the property a supplemental information field form (IFF) will be completed as detailed in the site-specific guidance document for the completion of IFFs.

U.S. Forest Service Land

In addition to the residential and commercial properties, a large area of U.S. Forest Service (USFS) land (Kootenai National Forest [KNF]) is within the study area. CDM will coordinate with the KNF forest supervisor to determine the locations of USFS-

owned structures within the study area. Access agreements will be obtained, and screening and sampling times will be scheduled so the necessary information for these structures can be collected.

4.3.2 Public Awareness and Reconnaissance

Communicating information to the public regarding the CSS investigation is invaluable to the success of this investigation. The communications aspect of the CSS investigation will include:

- Community relations
- Reconnaissance team

4.3.2.1 Community Relations

CDM will coordinate with the EPA CIC to ensure sufficient advertising (e.g., public meetings, newspaper articles, door flyers, radio announcements, etc.) will be conducted in conjunction with the investigation process. The roles and responsibilities of the CIC are discussed in Section 1. Initially, public announcements regarding the CSS will be advertised throughout the study area to familiarize the community with the investigation approach.

4.3.2.2 Reconnaissance Team

Personal visits will be conducted at the property owners' home and be performed by a CDM reconnaissance team, consisting of two team members each. The visit will include explaining the screening and soil sampling process, answering any pertinent questions, obtaining signed access agreements and any additional useful information (e.g., time when property owner will most likely be available), and completing the verbal and visual inspection discussed below. If property owners are not available during the reconnaissance, the teams will leave a flyer detailing CSS investigation and contact information. The reconnaissance team will revisit properties up to five times. If property owners cannot be contacted on the fifth visit, a letter will be sent to the property address informing the owner of the attempts made to contact them.

Access agreements will be obtained before any screening or sampling activities begin. If a property owner refuses to allow the CSS investigation to be conducted on their property, field activities will not be conducted. A list of property owners who refuse to participate in the CSS will be maintained and provided to the EPA RPM.

4.3.2.3 Contingency Issues

Various scenarios may arise that necessitate prioritizing and scheduling a CSS investigation at specific properties. These scenarios may include, but not be limited to:

- Real estate transactions
- Excessive contamination exposure (e.g., Libby vermiculite attic insulation falling into living space)

- Property damage (e.g., fire, flood, etc.)
- Current remodeling efforts (e.g., exposed areas)
- Community events (e.g., festivals, fairs, parades, etc.)
- Limited times when property owner is available

These situations will be addressed on a case-by-case basis. When a specific property does require an immediate investigation, the property owner will be contacted to schedule an appointment as soon as possible. A field team will then be dispatched to that property to complete the investigation.

4.3.3 Field Screening and Sampling Activities

The CDM reconnaissance and field teams will perform the CSS screening and sampling activities. The CSS screening and sampling activities will include:

- Visual inspection
- Verbal interview
- Soil sampling

The reconnaissance team will be responsible for indoor and outdoor visual inspections as well as conducting the verbal interview with the property resident and/or owner. Information collected during the visual inspections and verbal interviews will be recorded on an address-specific IFF. Once the reconnaissance team is through with their activities at a particular property, a field team will be dispatched to that property. The field team will be responsible for conducting the soil sampling.

4.3.3.1 Visual Inspection

The reconnaissance team will visually confirm the presence or absence of VCI within each structure located at a property. One team member will access the attic and perform a visual inspection, documenting pertinent information in the field logbook and screening questionnaire (e.g., IFF). The team member will check under other types of insulation (e.g., blown-in cellulose, fiberglass, etc.) to verify that VCI is not hidden. In addition, the team will investigate other areas where VCI may be exposed in living spaces (e.g., closets, circuit breaker boxes, etc.).

The reconnaissance team will also inspect all exposed soil areas within the property, paying special attention to areas where known sources of LA may have been introduced and "high traffic" areas where contamination is most likely to be tracked indoors. Soil samples will not be collected from specific land use areas (e.g., current or former flowerbeds, current or former gardens, planters, or stockpiles) where visible vermiculite product is observed. Instead, the field team will record the locations of the observed vermiculite in the field logbook and the IFF. If vermiculite is observed in a large portion of the property (e.g., yard, driveway, parking lot), one soil sample will

be collected from each of these use areas in order to determine if LA is present and remediation is required.

Sketch Property
The reconnaissance team will draw a site layout sketch of the property. This sketch will include major features (e.g., trees, drainage ditches, utility poles, known underground utilities, etc.). Sampling locations will be added by soil sampling teams. The site layout sketch will be drawn on the IFF.

The PPE required for the fieldwork is detailed in the HASP (Appendix B).

4.3.3.2 Verbal Interview

The screening process will also include a verbal interview, conducted by the reconnaissance team, with the property resident and/or owner to acquire background information on the property. The verbal interview is organized to collect as much known history about the property and/or structures to satisfy the DQOs (Section 3). The verbal interview process will involve the following steps:

- Obtain access agreements (if necessary)
- Conduct interview

Obtain Access Agreements
Access agreements will be collected during the reconnaissance team visit with property owners.

Conduct Interview
The interview will address issues such as the use of VCI (in the house, sheds, barns, etc.) and the possible introduction of other sources within (e.g., garden, landscaped areas, etc.) or near (e.g., neighbor) the property. Additional information regarding mine exposure, asbestos-related diseases, and the use of vermiculite in building materials on the property will be collected. The information collected during the interview will be recorded on an IFF (Appendix C).

Buildings within a specific property will be classified as primary or secondary. A primary building is the main habitable structure (e.g., house, apartment, main commercial space). Secondary buildings include non-habitable structures (e.g., garages, sheds, barns, etc.). A visual inspection to confirm the presence or absence of VCI and visible outdoor vermiculite will be performed and an IFF will be completed for every primary structure. IFFs will only be completed for secondary structures if vermiculite is observed in the structure. For secondary structures containing vermiculite, a secondary structure IFF will be completed (Appendix C). If secondary structures are present on a property and do not contain vermiculite, this information will be recorded in the field logbook and in the additional comments section of the primary IFF.

4.3.3.3 Soil Sampling

The purpose of soil sampling will be to identify outdoor soil sources of LA. These sources, although randomly distributed throughout the Libby study area, had specific uses within a property (e.g., soil amendment for gardens and a fill material). Therefore, the sampling was designed to identify these sources in soils where exposure is most likely to occur.

A two person sampling team will conduct soil sampling activities after the reconnaissance team has finished the visual inspection and verbal interview at the property. The soil sampling process will involve the following steps:

- Segregate land use areas and zones (if applicable)
- Visually inspect land use areas for vermiculite or LA-containing rock
- Determine sampling locations
- Collect samples
- Update property sketch
- Record sample locations using global positioning system (GPS) equipment

Segregate Land Use Areas

The property will be sectioned into land use areas for sampling purposes. Use areas may include, but not be limited to:

- Yard (grassy areas)
- Landscaped area
- Garden
- Fill area

Properties greater than ½ acre in size will be sectioned off into separate zones for increased accuracy in characterization. Sectioning properties into additional zones will be at the discretion of the CDM field team but consistent among the teams. This segregation will be accomplished so that a five-point composite sample will characterize the section. A five-point composite sample will be collected for land areas less than or equal to 1/8 of an acre.

Since most commercial properties have limited areas of soil and/or grass, soil samples will only be collected if these areas are present. If no soil is present, a note will be made in the on-site tracking system to indicate that no soil samples were collected due to the lack of soil.

Determine Sampling Locations
In areas where high concentrations of LA are expected (e.g., yard, garden, stockpiled soil, etc.), it is assumed that the sources were distributed throughout the area (e.g., tilling into a garden). Because of this, composite soil samples will be collected from similar land use areas (e.g., yard, garden, stockpiled soil, etc.). For example, a composite yard sample will only include subsamples originating from the yard land use area (e.g., no garden, fill soils included). Additional composite or grab samples may be collected depending on site conditions (e.g., multiple land use areas, zones, etc.). Conversely, not all land use areas previously mentioned will be applicable at every property and fewer samples (not less than two) will be collected. Up to five composite soil samples will be collected at each property. The CDM field team will use professional judgment in determining how soil samples will be collected in order to adequately characterize each property. Soil samples may also be biased to be collected near observed sources of vermiculite. An example sampling diagram, detailing how soil samples will be segregated, is included as Figure 4-6.

Two to five composite samples will be collected at each property. For non-disturbed areas (e.g., yard), composite samples will be collected from 0 to 1 in. For disturbed areas (e.g., garden, fill area, landscaped areas, etc.), composite samples will be collected from 0 to 6 in. These depths were chosen based on the site conceptual model. Mechanical disturbance, resulting in release and exposure to LA, to the 6-in. depth is likely in areas such as gardens or play areas through rototilling and digging; whereas, mechanical disturbance is only likely on the surface for grassy areas through mowing. All composite soil samples will have no more than five subsamples (e.g., five-point composite sample). Site conditions may require that fewer subsamples be collected.

Collect Samples
All soil samples will be collected in accordance with SOP CDM-LIBBY-05, Site-Specific Standard Operating Procedure for Soil Sample Collection.

Update Property Sketch
The location of all soil samples will be added to the property sketch created by the reconnaissance teams that is included on the IFF.

Record GPS Locations
For each sample collected and structure surveyed, a GPS point will be recorded. The GPS point will be collected outside the main entrance to each structure. Since soil samples will consist of composites, the midpoint of each composite group of samples will be recorded. All necessary information will be entered into the GPS data dictionary.

Location identification numbers will be assigned for each sample location. Location identification numbers include building location identification numbers (BD) and sample point location identification numbers (SP), as discussed below. Each structure on a property will be surveyed using GPS field equipment, and a location identification number associated with the structure will be assigned. Identification

numbers associated with structures will be in the form BD-#####. For each sample point collected outside a building, GPS points will be collected, and the location identification number associated with the sample point will be in the form of SP-#####. The procedure for fully implementing this process is currently in development by CDM and the Volpe Center and will be incorporated into this SAP when finalized.

4.3.4 Sample Analysis and Data Validation

Soil samples will be prepared for analysis following the CSF operations plan (CDM 2003d). The analytical program that will be used for identifying LA in soils will be determined following the current performance evaluation study being conducted by EPA. Once a determination is made regarding the analytical approach, this SAP will be amended. EPA is currently developing data validation criteria for soil sample results. When these procedures are established, this SAP will be amended to include these procedures.

When sample data packages are received, the RAC project manager (PM) will coordinate the data validation and entry of qualifiers added during validation to results in the Libby project database. The data validation procedures are currently under development EPA. When these procedures are finalized, this document will be amended. The RAC PM will notify the CIC as samples are validated and results are available from the Libby Project Database. The CIC will draft an initial letter format, and CDM will then complete a letter to each property owner and/or occupant detailing the results of the investigation and additional information regarding any necessary further activities.

Figure 4-1: CDM Team Members Associated with Each Step of the CSS Process

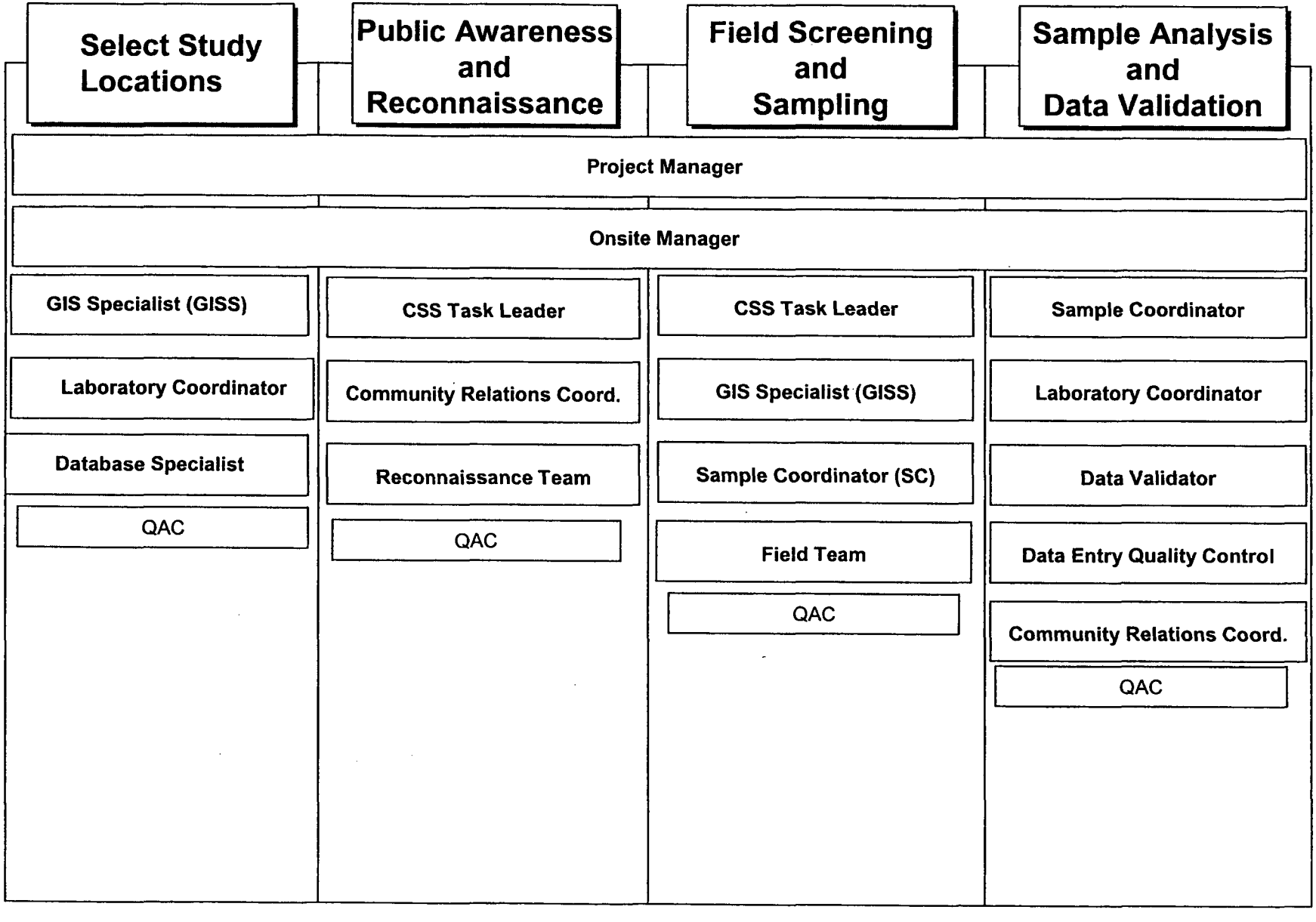


Figure 4-2: Responsibilities by Team Member for Selecting Study Locations

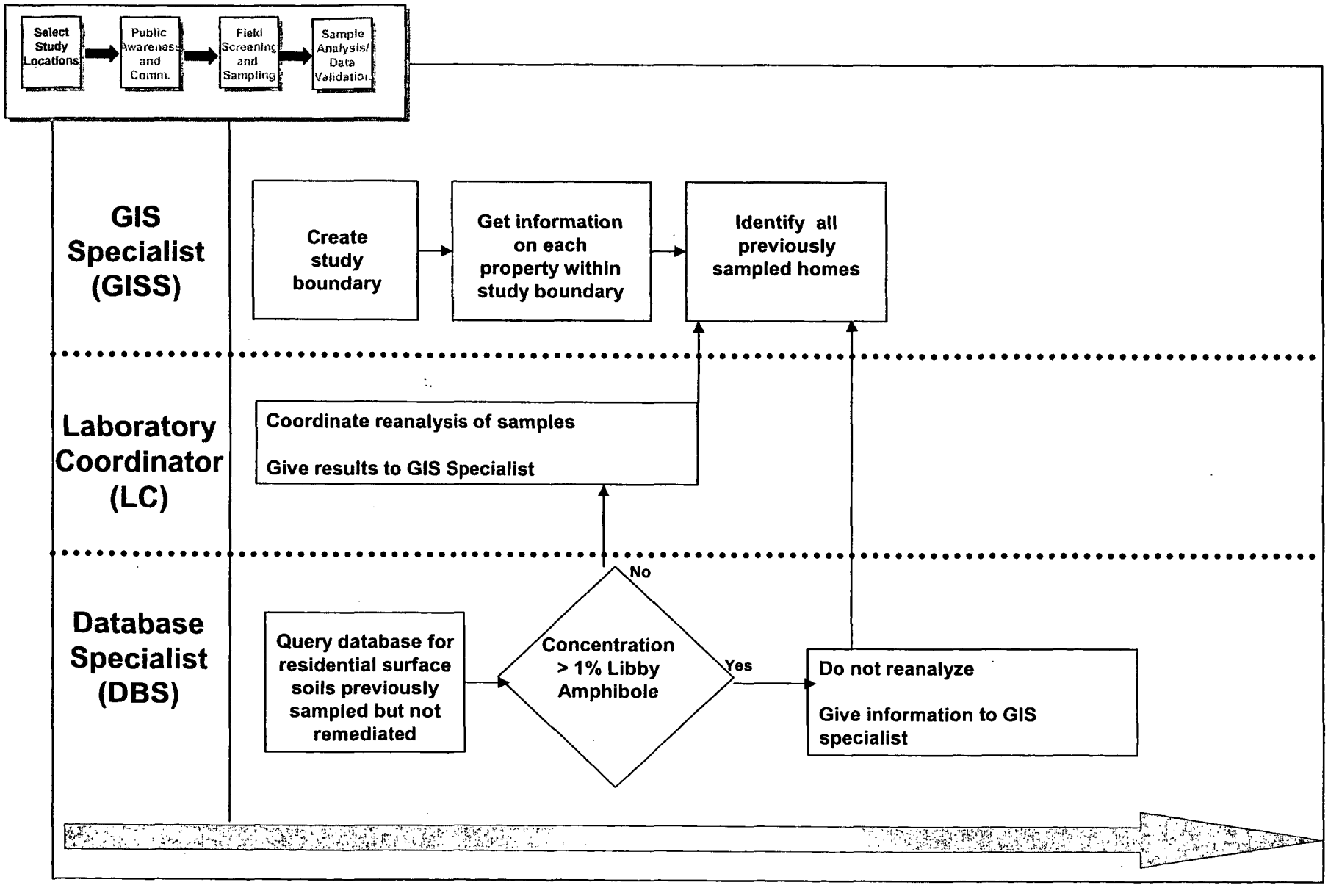


Figure 4-3: Responsibilities by Team Member for Public Awareness and Reconnaissance

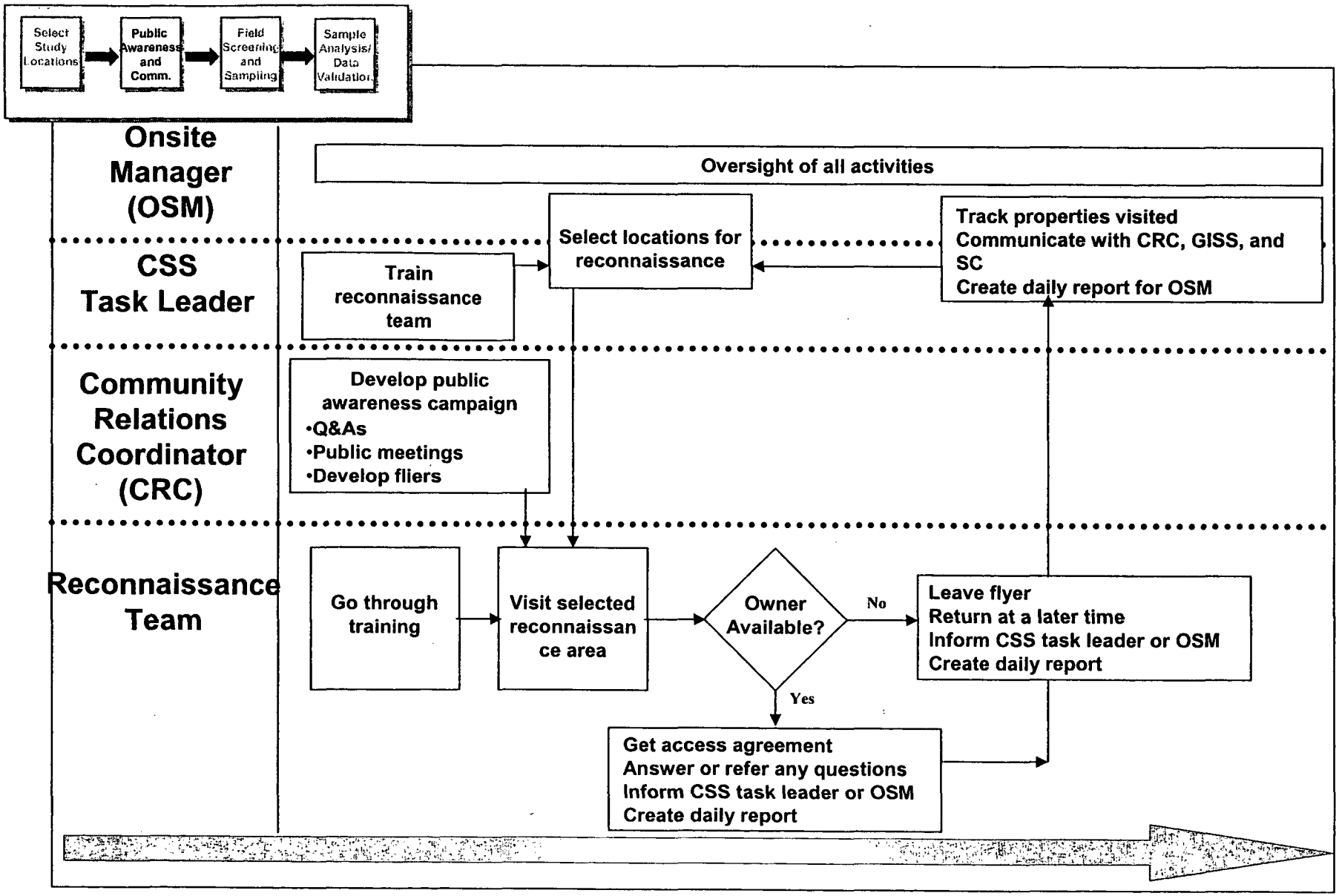


Figure 4-4: Responsibilities by Team Member for Field Screening and Sampling

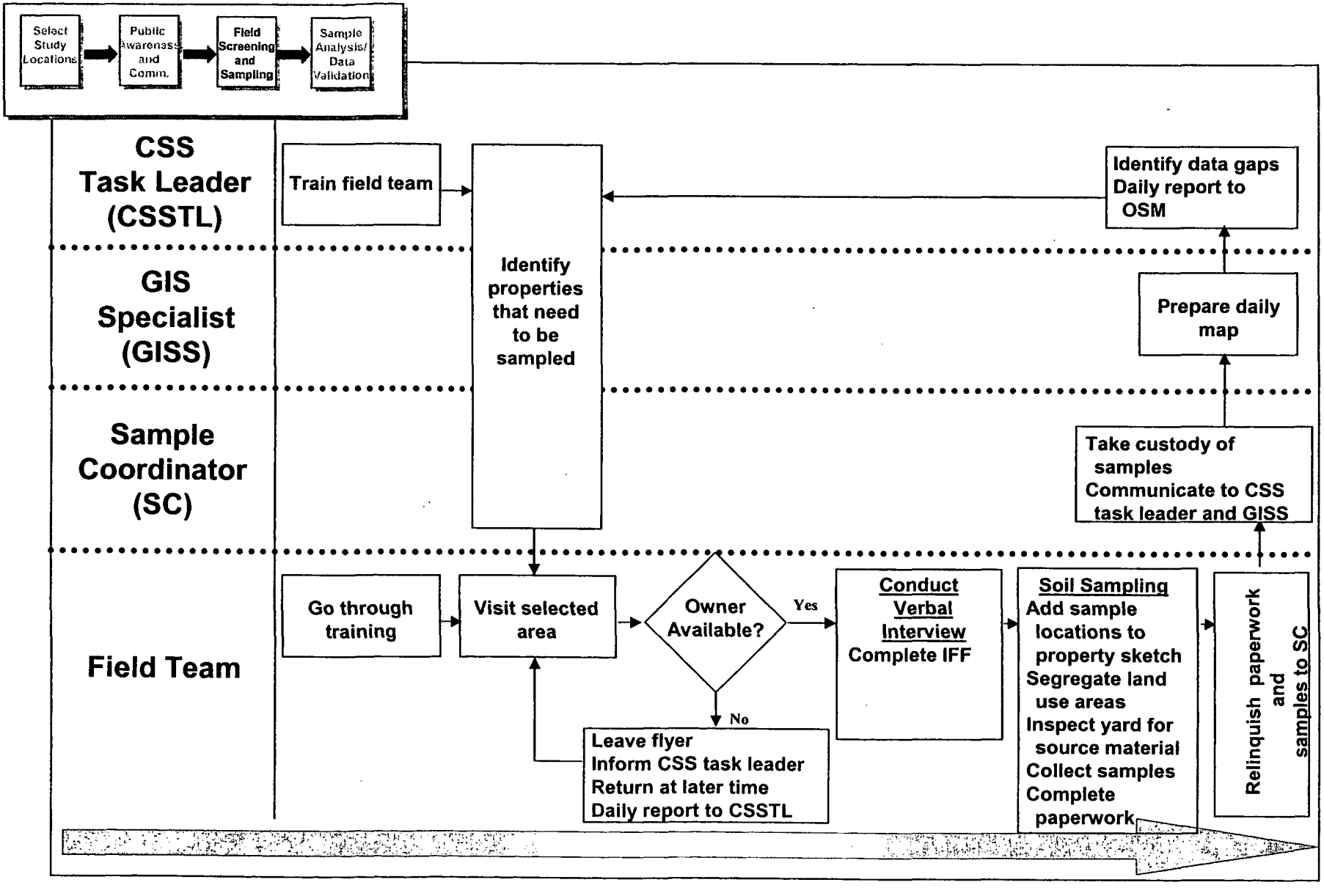
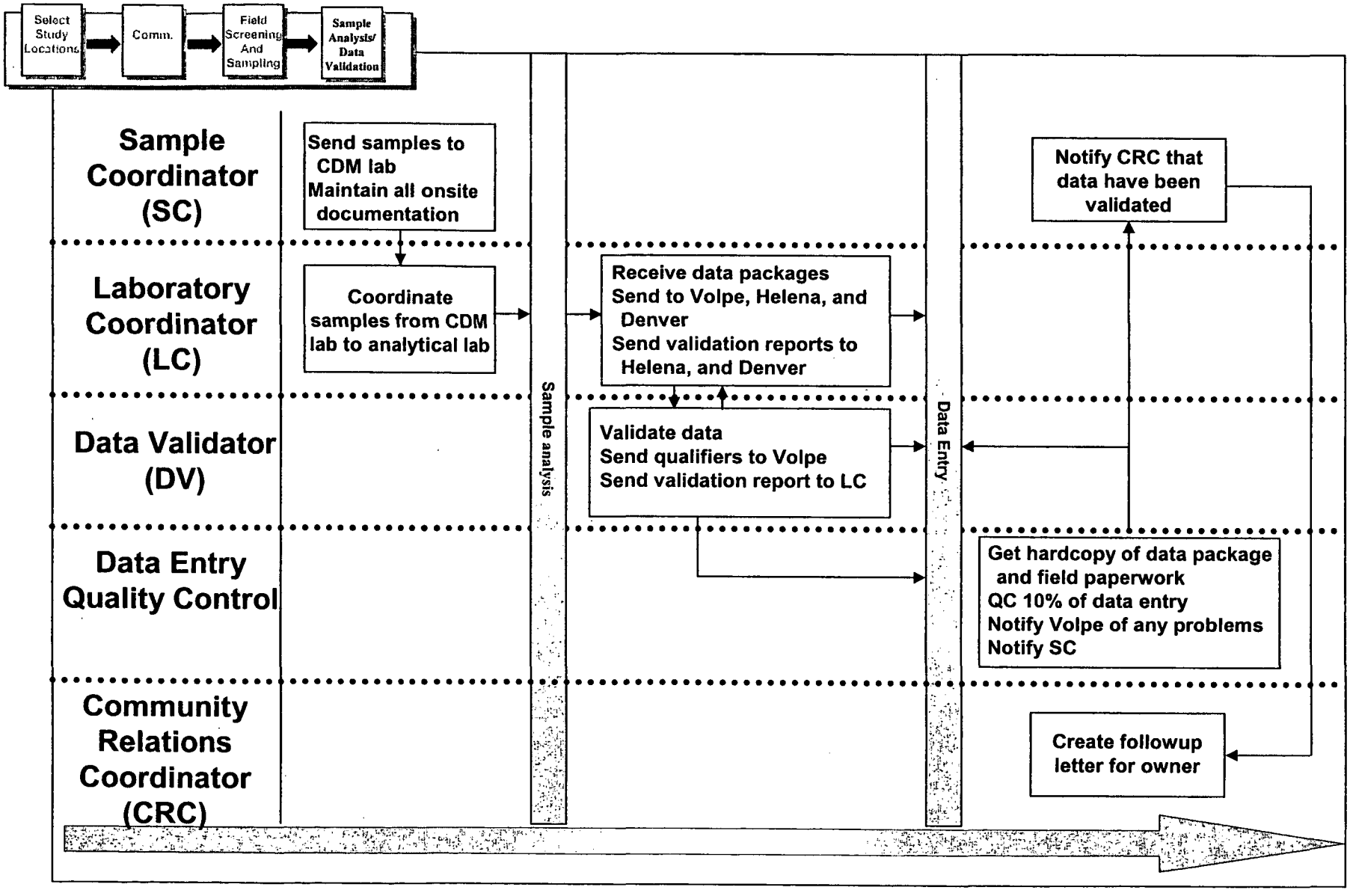


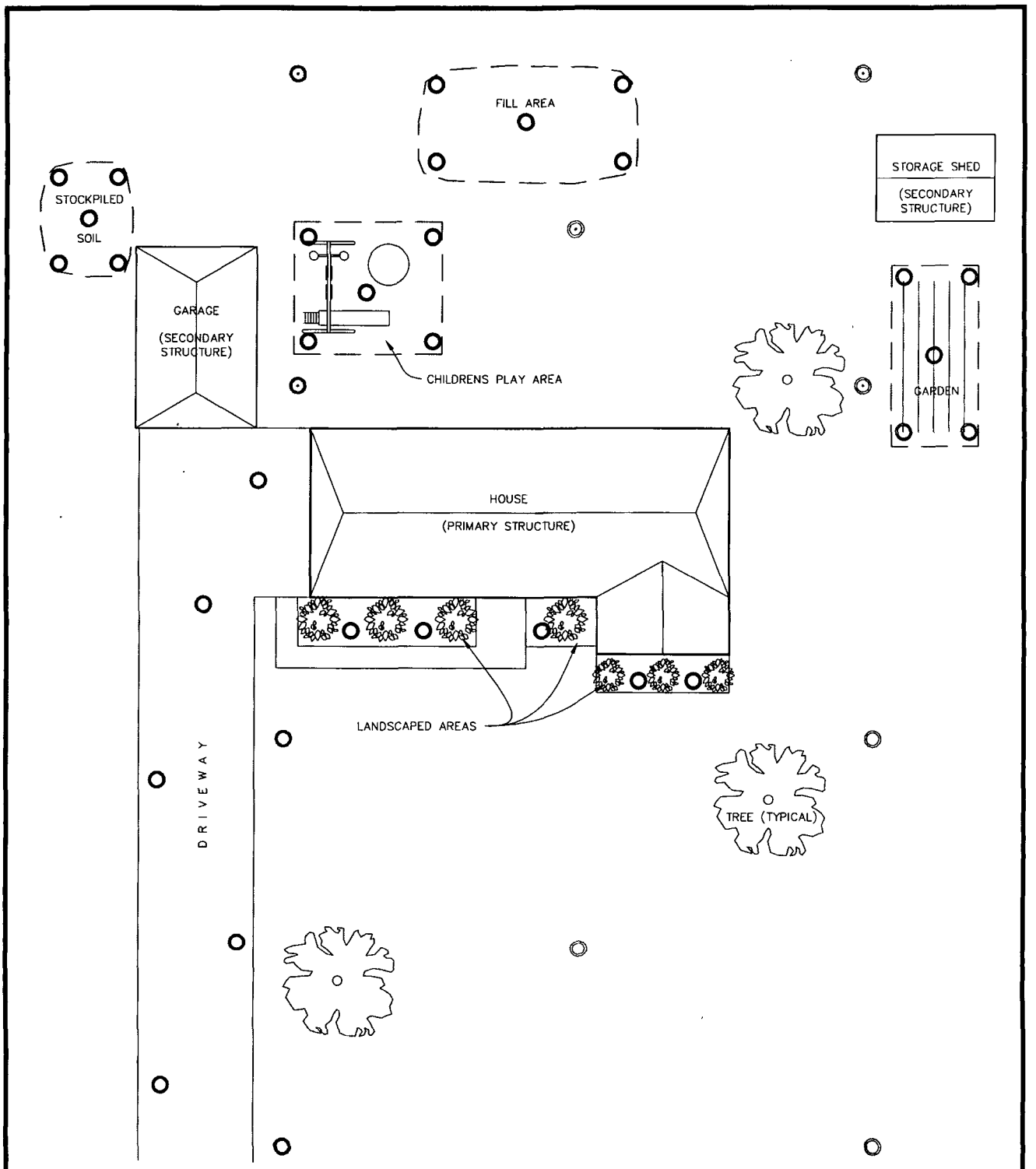
Figure 4-5: Responsibilities by Team Member for Sample Analysis and Data Validation



Color Map(s)

The following pages contain color that does not appear in the scanned images.

To view the actual images, please contact the Superfund Records Center at (303) 312-6473.



NOT TO SCALE

LEGEND

- DRIVEWAY SAMPLE (0-6")
- FRONT YARD SAMPLE (0-1")
- BACK YARD SAMPLE (0-1")
- LANDSCAPED AREA SAMPLE (0-6")
- GARDEN SAMPLE (0-6")
- OPPORTUNITY SAMPLE (0-6")

Figure 4-6

Example Sampling Locations and Property Site Layout

Libby Asbestos Project
Libby, Montana

CDM

T:\CADD\LIBBYSITE.dwg 04/29/02

Section 5
Field Activity Methods and Procedures

The following is a summary of field activities that will be performed by CDM personnel during the CSS investigation at Libby, Montana.

- Mobilization/demobilization
- Field documentation
- Screening questionnaire
- Soil sample collection
- Equipment decontamination
- Investigation-derived waste containment

The following subsections reference CDM SOPs, where applicable, or provide site-specific procedures if there are not applicable SOPs. The following SOPs (CDM 2002c) and site-specific guidance documents are included in Appendix C:

SOP 1-2	Sample Custody (with modifications)
SOP 2-1	Packaging and Shipping of Environmental Samples (with modifications)
SOP 2-2	Guide to Handling of Investigation-Derived Waste (with modifications)
SOP 4-1	Field Logbook Content and Control (with modifications)
SOP 4-2	Photographic Documentation of Field Activities (with modifications)
SOP 4-5	Field Equipment Decontamination at Nonradioactive Sites (with modifications)

Three site-specific guidance documents have been developed to standardize the completion of field forms. These guidance documents are included in Appendix C.

CDM-LIBBY-03 Revision 1	Completion of Field Sample Data Sheets (FSDS)
CDM-LIBBY-04 Revision 1	Completion of IFFs
CDM-LIBBY-05 Revision 1	Site-Specific Standard Operating Procedures for Soil Sample Collection

The HASP is included in Appendix B.

5.1 Mobilization/Demobilization

CDM supported the ERB activities in Libby since 1999 and currently leases office space at 318 Louisiana in Libby. As a result, the majority of mobilization activities associated with initial setup are complete. However, startup activities for this sampling season will need to take place.

CDM will identify and provide all necessary personnel, equipment, and materials for the purpose of conducting the CSS investigation. A complete inventory of available equipment and supplies will be conducted prior to initiating the field activities and any additional required equipment or supplies will be obtained. All field personnel will be trained in the field on the objectives of the CSS as well as specifics on how to perform their assigned tasks.

CDM has identified the equipment and supplies necessary to support the CSS field activities. These items are summarized in Table 5-1. CDM will provide all sampling equipment used to collect and contain samples for analyses. Prior to acceptance, a field team leader will inspect all supplies and consumables to ensure that they are in satisfactory condition and free of defects.

Prior to the mobilization for field activities, a field-planning meeting will be conducted by the CDM onsite manager and attended by the CDM project manager, available field staff, health and safety officer (HSO), and a member of the QA staff. The CDM onsite manager will notify a member of the QA staff and an HSO of the agenda before the meeting. The agenda will be reviewed and approved by the QA staff and the HSO prior to the meeting. In addition, daily field planning meetings will be held at the CDM Libby office by the CDM onsite manager and attended by the current field staff. The participants at all meetings will sign an attendance list. The field-planning meeting will discuss and clarify:

- Objectives and scope of the field work
- Equipment and training needs
- Number and types of samples and analyses
- Field operating procedures, schedule of events, and individual assignments
- Required QC measures
- Safety issues
- Documents governing fieldwork that must be on site
- Community relations
- Interactions with the media
- Any changes in the field planning documents

Additional meetings will be held when the documents governing fieldwork require it or when the scope of the assignment changes significantly.

Daily field planning meetings will discuss the previous days events and planned activities for the current day. Any changes to project procedures, schedules, or other

pertinent project updates will be discussed. New field team members will be introduced and assigned to work with an experienced team member.

Copies of the field planning meeting agenda, daily field planning meeting notes, and meeting attendance lists will be distributed to the project files by the CDM project manager.

5.2 Field Documentation

Detailed sampling notes will be recorded for each sample in accordance with CDM SOP 4-1, Field Logbook Content and Control. Photographic documentation will be recorded for each site in accordance with CDM SOP 4-2, Photographic Documentation of Field Activities. For each property surveyed, the BD number of the IFF form and FSDS number should be referenced in the logbook. FSDSs and IFFs will be completed for each site in accordance with the CDM project-specific SOP, Completion of Field Sample Data Sheets. An example FSDS is included in Appendix C.

5.2.1 Field Logbooks and Records

Field logbooks will be maintained in accordance with SOP 4-1, Field Logbook Content and Control. The log is an accounting of activities at the site and will duly note problems or deviations from the governing plans and observations relating to the sampling and analysis program. A new logbook page will be completed for each property visited. The header information should include the address, the property owner's name, and primary and secondary structure BD numbers. When closing out a logbook page with lineout and signature, the author will also print his/her name underneath the signature. The sample coordinator will manage the logbooks and will send original field logbooks, as they are completed, to the CDM office in Helena, Montana for document control. A copy of each logbook will be maintained in the CDM office in Libby, Montana and Denver, Colorado. The distribution of all field paperwork is discussed in Section 5.10.

5.2.2 Corrections to and Deviations from Documentations

Logbook modification requirements are described in CDM's SOP 4-1, Field Logbook Content and Control. For the logbooks, a single strikeout initial and date is required for documentation changes. The correct information should be entered in close proximity to the erroneous entry. These procedures will also be followed for the correction of any field form (FSDS, IFF, and COC). All deviations from the guiding documents will be recorded in the logbooks and the Libby Asbestos Project Record of Deviation/Request for Modification Form (Appendix D). Any major deviations will be documented according to the quality management plan (CDM 1996b).

5.3 Screening Questionnaire

An IFF screening questionnaire will be completed for each structure within a property boundary, as described in Section 4.3.3.1. Information will be obtained from the property owner and occupant (if different). All IFFs will be completed in accordance

with the CDM project-specific SOP, Completion of Property Information Field Form. An example IFF is included in Appendix C.

5.4 Soil Sampling

The procedures presented in this section are brief summaries of the referenced SOPs and provide additional site-specific detail that may not be discussed in the individual SOPs. For additional information, CDM field personnel will refer to the SOPs included in Appendix C. The HASP should be consulted to determine the health and safety protocol for performing specific activities.

Soil samples will be collected from specific land use areas as described in Section 4.3.3.32. All soil samples will be collected in accordance with CDM SOP CDM-LIBBY-05.

5.4.1 Sample Preparation

All soil samples will be shipped to the designated laboratory for further preparation (i.e., drying, splitting, archiving, etc.) in accordance with the CSF operations plan (CDM 2003e).

Chain-of-custody procedures will be maintained from sample collection through the processing phase and subsequent shipping to the analytical laboratory. Prior to the shipment of any samples for analytical analysis, the laboratory coordinator will be contacted to determine the appropriate laboratory that should receive those samples. The laboratories that will provide analytical services have not yet been identified.

5.4.2 Field Equipment Blanks

Soil samples will be collected using non-disposable equipment (i.e., trowels, bowls, spoons, etc.). Field equipment blank samples are collected to determine if decontamination procedures of field equipment used to collect asbestos samples are adequate to prevent cross-contamination of samples during sample collection.

Field equipment blanks will be collected once a week from equipment used by different field teams to collect soil samples for asbestos analysis. These samples will be collected using silica sand that is asbestos free as analyzed by PLM. Field equipment blanks will be collected by placing silica sand in a decontaminated mixing bowl used to homogenize samples. The silica sand will be mixed in the bowl using decontaminated equipment that was used to collect soil samples. The silica sand will then be submitted as a sample for analytical analysis. The frequency of field equipment blanks may be adjusted, as the relationship between cross-contamination and sample results is understood. If the required frequency is adjusted, the change and supporting rationale will be documented as described in Section 5.2.2.

5.4.3 Field Duplicate Samples

Soil field duplicate samples will be collected at a rate of 1 per 20 (5 percent) of the field samples. Field duplicate samples will be collected as samples co-located in the

same land use area. The duplicate will be collected from the same number of subsamples as the parent sample, but the subsample locations of the duplicate sample will be randomly located in the use area. These samples will be independently collected with separate sampling equipment. These samples will be used to determine the variability of LA concentrations in a given land use area. These samples will not be used to determine precision in sampling techniques.

5.5 Field Sample Custody and Documentation

Sample custody and documentation will follow the requirements specified in CDM's SOP 1-2 Sample Custody and site-specific SOPs for completion of FDSS and electronic chain-of-custody (eCOC) forms. All samples and sampling paperwork (chain-of-custody forms, field data sheets, survey forms, etc.) will be relinquished to the sample coordinator at the end of each day. The sample coordinator will be responsible for management of all IFFs, FSDSs, and COCs. The distribution of all field paperwork is discussed in Section 5.10.

The sample coordinator assistant will use the FSDS to complete an eCOC. The sample coordinator will check the data entered to create the eCOC against the FSDSs. Three paper copies of the eCOC will then be generated. One copy will be filed in the CDM Libby office and the other two will accompany sample shipments. The sample coordinator will check the eCOC versus the sample containers and sample shipment. The sample coordinator will be responsible for shipment of samples. If any errors are found on an eCOC after shipment, the paper copy of the COC stored in Libby will be corrected by the sample coordinator with a single strikeout initial and date. The corrected copy will be faxed to Volpe and the laboratory. The fax to Volpe will be used to update the Libby project database.

5.6 Sample Labeling and Identification

Soil samples will be labeled with index identification numbers supplied by the Volpe Center. These numbers will be maintained by the sample coordinator and signed out by sampling teams. Sample index identification numbers will identify the samples collected during the CSS by having the following format:

CS-#####

Where:

CS = Contaminant screening study
= A sequential five digit number

5.7 Chain-of-Custody Requirements

Chain-of-custody (COC) procedures and sample shipment will follow the requirements stated in CDM's SOP 1-2, Sample Custody and SOP 2-1 Packaging and Shipping of Environmental Samples. The COC record is used as physical evidence of sample custody and control. This record system provides the means to identify, track,

and monitor each individual sample from the point of collection through final data reporting. A complete COC record is required to accompany each shipment of samples. COC completion procedures are detailed in section 5.6.

The sample coordinator will follow COC procedures to ensure proper sample custody between acceptance of the samples from the field teams to shipment to the laboratory.

5.8 Sample Packaging and Shipping

Samples will be packaged and shipped in accordance with CDM's SOP 2-1, Packaging and Shipping of Environmental Samples, with modification. Custody seals will be placed over at least two sides of the cooler and then secured by tape if custody is released to a non-sampler. All samples will be shipped by an overnight delivery service to the designated laboratory. The sample coordinator will be responsible for packaging and shipment of samples. The following modifications to SOP 2-1 have been reviewed and approved:

Section 1.4, Required Equipment - Vermiculite (or other absorbent material), bubble wrap, or ice will not be used for packaging or shipping samples.

Section 1.5, Procedures - No vermiculite or other absorbent material will be used to pack the samples. No ice will be used.

5.9 Field Paperwork Distribution

The distribution of all field paper work is discussed below and presented in Figure 5-1, and the paperwork flow process at the Volpe Center is provided in Appendix E.

Access Agreements

Original access agreements will be filed in the residential folders maintained in the CDM Libby office. Copies also will be sent to both the CDM Helena and CDM Denver offices for the Volpe Center and RAC project files, respectively. These copies will be sent on Fridays by a courier service (i.e., Federal Express).

Information Field Forms

Original IFFs will be filed in Libby by BD number. Copies will be filed in the residential folders maintained in the CDM Libby office. Copies also will be sent to both the CDM Helena and CDM Denver offices for the Volpe Center and RAC project files, respectively. These copies will be sent on Fridays by a courier service (i.e., Federal Express).

Field Sample Data Sheets

Original FSDSs will be filed in Libby by sheet number. Copies will be filed in the residential folders maintained in the CDM Libby office. Copies also will be sent to both the CDM Helena and CDM Denver offices for the Volpe Center and RAC project files, respectively. These copies will be sent on Fridays by a courier service (i.e.,

Federal Express). An additional copy will be faxed to the Volpe Center daily for data entry.

Chain-of-Custody Forms

Two of the COCs will accompany samples during shipment. A copy of all COCs will be maintained in the Libby office, and be filed by COC number. An additional copy will be sent to the CDM Denver office for the RAC project files. These copies will be sent on Fridays by a courier service (i.e., Federal Express). In addition, eCOCs will be sent to Volpe daily for upload into the Libby project database.

Logbooks

As logbooks are completed, originals will be sent to the CDM Denver office for the RAC project files. Copies will be maintained in the CDM Helena office (for the Volpe project files) and in the Libby office. In addition, pages relevant to a specific property will be maintained in the residential file folders in the Libby office.

Data Packages and Data Validation Reports

Original data packages and data validation reports will be filed in the CDM Denver office in the RAC project files. Copies will be maintained in the CDM Helena office in the Volpe project files.

5.10 Equipment Decontamination

Equipment used to collect, handle, or measure soil samples will be decontaminated in accordance with CDM SOP 4-5, Field Equipment Decontamination at Nonradioactive sites, with modifications. The following modifications to SOP 4-5 have been reviewed and approved:

Section 4.0, Required Equipment - Plastic sheeting will not be used during decontamination procedures. ASTM Type II water will not be used. Rather, locally available deionized water (DI) water will be used.

Section 5.0, Procedures - Decontamination water will not be captured and will be discharged to the ground at the property.

Section 5.6, Waste Disposal - Decontamination water will not be captured and will not be packaged, labeled, or stored as investigation-derived waste (IDW).

Decontamination procedures for soil sampling equipment will follow these steps:

- Remove all gross contamination with plastic brush
- Use DI water and a plastic brush to wash each piece of equipment
- Remove excess water present on the equipment by shaking
- Use a paper towel to dry each piece of equipment

- Wrap dried equipment in aluminum foil

Once a week all soil sampling equipment will be cleaned using Alconox and DI water.

All equipment used in attics will be wet-wiped immediately after use.

5.11 Investigation-Derived Waste

IDW at each property will consist of excess sample volume, spent decontamination supplies, and personal protective equipment (PPE). All IDW will be handled in accordance with CDM SOP 2-2, Guide to Handling IDW, with modifications. The following modifications to SOP 2-2 have been reviewed and approved:

Section 5.2, Offsite Disposal - All spent sampling IDW (i.e., paper towels, respirator cartridges, etc.) will be collected in transparent garbage bags and marked "IDW" with an indelible marker. These bags will be deposited into the asbestos-contaminated waste stream for disposal.

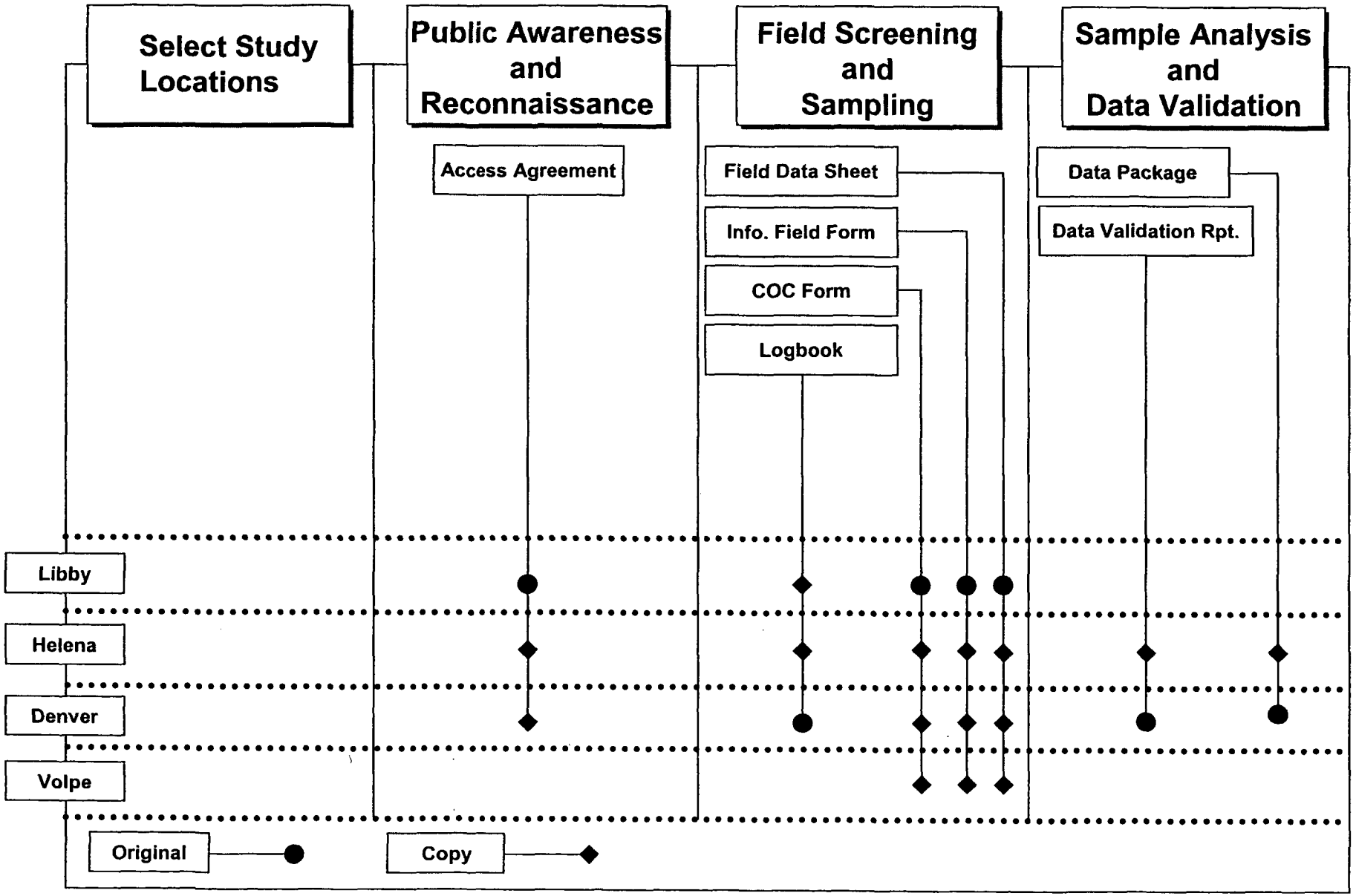
5.12 Health and Safety Air Monitoring

Air samples will be collected for health and safety. Procedures are outlined in the Phase I QAPP (EPA 2000a).

Table 5-1 Sampling Supply and Equipment Checklist

General	
SAP	Alconox (4 pound box)
Access agreement forms (completed and blank)	Water sprayer
Information field forms (screening questionnaire)	Scrubbing brush (2)
Field logbook	De-ionized water (2 gallons)
FSDS	Primary flow calibrator
Chain-of-custody (COC) forms	Aluminum foil
Sheets of index IDs	Paper towels
Sheets of location IDs	Measuring tape
GPS unit	Tape - clear, duct, and strapping
Digital camera	Ice chests (2)
Trowel or bulb planter	Garbage bags (transparent)
Mixing bowl/Spoons	Ladder
Zip-top plastic bags (quart size)	Flashlight
Indelible markers and pens (Sharpie, extra fine)	Information flyer (to be left with property owner)
Air sampling pumps	MCE microvacuum cassettes
Decon buckets - 5 gallon	Clipboards
Health and Safety	
First aid kit	Steel-toed boots
Tyvek coveralls	Gloves - cotton and nitrile
Respirator and cartridges (see HASP)	Respirator cleaning wipes
Safety glasses	Cellular telephone/radio
Fire extinguisher	

Figure 5-1: Document Filing Associated with Each Step of the CSS Process



Section 6
Laboratory Analysis and Requirements

The laboratories used for all sample analyses will have participated in, and acceptably analyzed, the required parameters in the last two proficiency examinations from both the National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program (NIST/NVLAP). The laboratory must also analyze performance evaluation samples on a voluntary basis. These analyses must be performed before any samples are submitted to the laboratory to confirm the laboratory's capabilities and may be subsequently submitted at regular intervals. In addition, the laboratory must participate in the laboratory-training program developed by the Libby laboratory team. The current outline for this training program is provided in Appendix F, but is expected to be updated periodically as it is part of a continuous improvement program for analysis of Libby samples.

6.1 Analytical Methods

A range of asbestos analytical techniques are currently being considered for this investigation to identify potential LA in soil. Methods are currently being evaluated through a performance evaluation study conducted by EPA. Once the study is complete and the results reviewed, a determination will be made regarding the appropriate analytical method for soil. Once an analytical approach has been finalized, this SAP will be amended.

6.2 Reporting Limits

The reporting limit for soils has not been established. Once an analytical method is determined based on the performance evaluation study and a reporting limit is determined, this SAP will be amended.

6.3 Holding Times

Technical holding times are storage times allowed between sample collection and sample analysis when the designated preservation and storage techniques are employed. No preservation requirements or holding times are established for soil samples collected for asbestos analysis.

6.4 Laboratory Custody Procedures and Documentation

Laboratory custody procedures are provided in the laboratory's QA management plan, which is approved by CDM as part of the laboratory procurement process. Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipping cooler and the individual samples. This inspection will include verifying sample integrity. The enclosed COC records will be cross-referenced with all of the samples in the shipment. The laboratory sample custodian will sign these records and provide copies for placement in the project files. The sample custodian may continue the COC record process by assigning a unique laboratory number to each sample on receipt. This number, if assigned, will identify the sample through all further handling at the laboratory. It is the laboratory's

responsibility to maintain internal logbooks and records throughout sample preparation, analysis, and data reporting.

6.5 Laboratory Quality Assurance Program

Samples collected during this project will be analyzed in accordance with standard EPA and/or nationally recognized analytical procedures (i.e., Good Laboratory Practices [GLP]). The purpose of using standard procedures is to provide analytical data of known quality and consistency. Analytical laboratories will be provided a copy of and will adhere to the requirements of this SAP.

6.6 Documentation and Records

Data reports will be submitted to the CDM laboratory coordinator and include a case narrative that briefly describes the number of samples, the analyses, and any analytical difficulties or QA/QC issues associated with the submitted samples. EPA is currently developing the data report requirements. When the requirements are finalized this SAP will be revised. All original data reports will be filed in the CDM office in Helena, Montana and a copy filed in the CDM office in Denver, Colorado. The laboratory also will provide an electronic copy of the data to the laboratory coordinator and others as directed by CDM.

6.7 Data Management

Sample results data will be delivered to the Volpe Center and CDM's Cambridge office both in hard copy and as an electronic data deliverable (EDD). Electronic copies of all project deliverables, including graphics, will be filed by project number. Electronic files will be routinely backed up and archived.

All results, field data sheet information, and survey forms will be maintained in the Libby project database managed by the Volpe Center. The distribution of all paper work is discussed in Section 5.5 and shown in Figure 5-1.

Section 7
Quality Assurance/Quality Control Program

The field QA program has been designed in accordance with CDM's RAC VIII Quality Management Plan (QMP) (CDM 1996b), CDM's RAC Region VIII QAPP (CDM 1996a), EPA's Guidance for the DQO Process (EPA 2000b), and EPA's Requirements for QAPPs for Environmental Data Operations, QA/R-5, Final (EPA 2001b).

A QA/QC program has been developed for the CSS to ensure that the quality of the data collected in the field can be assessed. This section outlines where in the CSS process potential data quality problems can occur, what QA/QC measures are in place to monitor any problems, and what corrective actions will be taken to address those problems.

7.1 Study Process

QA/QC procedures can be found at each step within the CSS four-step process (i.e., selecting study locations, public awareness and reconnaissance, field screening and sampling activities, and sample analysis and data validation) (Figures 7-1 and 7-2). The QA/QC measures associated with the CSS study are discussed below followed by a detail of the study process, the potential problems with each step of the study process, the QA/QC measures designed to mitigate the problems, and the corrective actions to prevent reoccurrence of problems.

Reconnaissance and Field Team Orientation

Due to the longevity of the CSS, several field team members will rotate shifts throughout the field effort. CDM will make a conscious effort to utilize personnel (when available) with prior experience in performing similar activities in the Libby Asbestos Project Phase I investigation. All reconnaissance team members will be required to participate in a reconnaissance team orientation, which will cover the overall CSS process, personal communication skills, access agreement form completion, and identification of LA sources.

All field team members and the quality assurance manager (QAM) will be required to sign a required reading form indicated they have read and understand this SAP, and participate in a field team orientation, which will include discussing the investigation approach, sampling techniques, communication skills, access form completion, identification of LA sources, and proper completion of all field forms.

Field Form Completion Checks

All field forms (IFF and FSDS) will be completed in the field before leaving a property. To ensure that all applicable data is entered and all necessary fields are completed, a different field team member will check each field form. The CSS task leader will also complete periodic checks of all field forms.

Supplemental Verification

Supplemental verification of vermiculite product will be performed when the field team cannot identify, with confidence, vermiculite and/or sources of LA product. The CSS task leader will meet the field team at the property to assist in the identification process.

Screening Field Checks

Screening field checks will also be conducted by the CSS task leader. The CSS task leader will accompany the RI team during an investigation. The team will be critiqued on performance and data collection procedures. Screening field checks will be conducted at a rate of 2 percent (1 per 50) of the properties investigated.

Field Audits

A field audit will be performed during the first month of the field effort. If significant CSS procedural changes occur during the study, additional field audits will be conducted to ensure the new methods are implemented and followed appropriately. In addition, opportunistic audits may be necessitated by the findings of screening field checks completed by the RI task leader. The QAM will be the point of contact for the field audit, and be responsible for overseeing implementation of any corrective actions required or as requested by EPA. Field audit reports will be completed following each audit. This report is a CDM internal document and will be maintained in the RAC VIII project files in Denver; a copy of the audit report as well as any corrective action reports will be provided to EPA.

Field Duplicate Samples

Soil field duplicate samples will be collected at a rate of 1 per 20 (5 percent) of the field samples. Field duplicate samples will be collected as samples co-located in the same land use area. The duplicate will be collected from the same number of subsamples as the parent sample, but the subsample locations of the duplicate sample will be randomly located in the use area. These samples will be independently collected with separate sampling equipment. These samples will be used to determine the variability of sample results in a given land use are. These samples will not be used to determine variability in sampling techniques.

Field Equipment Blanks

Field equipment blanks will be collected once a week from equipment used by different field teams to collect soil samples for asbestos analysis. These samples will be collected using silica sand that is asbestos free as analyzed by PLM. Field equipment blanks will be collected by placing silica sand in a decontaminated mixing bowl used to homogenize samples. The silica sand will be mixed in the bowl using decontaminated equipment that was used to collect soil samples. The silica sand will then be submitted as a sample for analytical analysis.

Preparation Duplicate Samples

Preparation duplicate samples are splits of samples submitted for sample preparation prior to laboratory analysis. These samples serve to evaluate the variability of the sample preparation process and analysis. A preparation duplicate sample should be submitted at a frequency of 5 percent of the field samples prepared for analysis or one per preparation batch, whichever is more frequent. The acceptable criteria for a preparation duplicate are currently being developed.

Preparation Laboratory Equipment Blanks

Laboratory equipment blank samples are collected to determine if decontamination procedures of laboratory equipment used to prepare asbestos samples are adequate to prevent cross-contamination of samples during sample preparation. Laboratory equipment blanks will be collected at the end of each day of sample preparation from equipment used to prepare samples for asbestos analysis. These samples will be collected using silica sand that is asbestos free as analyzed by PLM. Silica sand will be prepared the same way a soil sample submitted from the field is prepared for analysis by the preparation laboratory. The silica sand will then be submitted as a sample for analytical analysis. The frequency of laboratory equipment blank sample collection may be adjusted, as the relationship between cross-contamination and sample results is understood. If the required frequency is adjusted, the change and supporting rationale will be documented as described in Section 5.2.2.

Grinding blank samples are prepared to determine if decontamination procedures of laboratory equipment used to prepare asbestos samples are adequate to prevent cross-contamination of samples during sample grinding and splitting. The grinding blank will consist of clean quartz sand and will be processed once per day, on days that field samples are ground. The grinding blank samples are given sample identification numbers provided to the CSF by sample coordination personnel in Libby, Montana. For each grinding blank prepared, an FSDS is completed as detailed in the CSS SAP, and a copy is sent to the sample coordinator and Volpe.

Data Entry Checks

Data entry into the Libby project database is performed by the Volpe Center with a 100 percent QC of the data. CDM will perform an additional 10 percent QC on all data entered into the database by comparing field data sheets, survey forms, COCs, and analytical data. This check will be performed on a daily basis on the data entered from the previous day.

7.1.1 Select Study Locations

Relevant property data (completed questionnaires and soil sample results) collected during the previous Phase I investigation will be evaluated to determine if sufficient information exists to satisfy the DQOs (Section 3). Soil samples collected from these properties during Phase I activities were analyzed by PLM and then archived. The archived sample will be submitted for additional analysis as described in Section

4.3.4. The potential problems and corrective actions associated with selecting study locations are presented below.

Potential Problem	QA/QC Measure	Corrective Action
Screen Previous Data		
Inaccurate data obtained in screen of previously collected data	Volpe Center database checks Field team review	Notify Volpe Center of incorrect information.

7.1.2 Public Awareness and Reconnaissance

Communicating information to the public regarding the CSS investigation is invaluable to its success. Communication will include community relations and sampling reconnaissance. No QA/QC measures have been developed for community relations; however, these measures do exist for sampling reconnaissance. The potential problems and corrective actions associated with public awareness and reconnaissance are presented below.

Potential Problem	QA/QC Measure	Corrective Action
Reconnaissance Team		
Incorrect completion of access agreements	Reconnaissance team orientation Field form completion checks Field audit to assess compliance of this study step with the SAP	Reorientation of access agreement completion procedures. Reorientation of access agreement completion procedures. Correction of errors on access agreement. Implement corrective actions of field audit.
Misinforming residents and/or owners of the CSS study process	Reconnaissance team orientation Field audit to assess compliance of this study step with the SAP	Reorientation of CSS study process. Implement corrective actions of field audit.

7.1.3 Field Screening and Sampling

The field screening process at each property will consist of both a qualitative (i.e., verbal interview and visual inspection) and quantitative (i.e., soil sampling) approach. The potential problems, QA/QC measures implemented, and corrective actions for each approach are presented below.

Potential Problem	QA/QC Measure	Corrective Action
Visual Inspection		
Incorrect completion of field form (IFF) from visual inspection	Field team orientation	Reorientation of IFF and source identification procedures.

Potential Problem	QA/QC Measure	Corrective Action
■ Presence or absence of Libby vermiculite attic insulation ■ Presence or absence of outdoor sources ■ Structure sketch ■ Property sketch	Field form completion checks	Reorientation of IFF and source identification procedures and additional checks of IFFs completed by the same team. Resubmit IFFs requiring correction to Volpe Center for revised data entry.
	Supplemental verification	Reorientation of source identification and additional screening field checks of inspections completed by the same team. Resubmit IFFs requiring correction to Volpe Center for revised data entry.
	Screening field checks	Reorientation of source identification and additional screening field checks of inspections completed by the same team. Resubmit IFFs requiring correction to Volpe Center for revised data entry.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Incorrect identification of sources	Field team orientation	Reorientation of source identification
	Field form completion checks	Reorientation of source identification and additional screening field checks of inspections completed by the same team. Resubmit affected paperwork requiring correction to Volpe Center for revised data entry.
	Supplemental verification	Reorientation of source identification and additional screening field checks of inspections completed by the same team. Resubmit affected paperwork requiring correction to Volpe Center for revised data entry.
	Screening field checks	Reorientation of source identification and additional screening field checks of inspections completed by the same team. Resubmit affected paperwork requiring correction to Volpe Center for revised data entry.
	Field audit to assess compliance	Implement corrective actions of

Potential Problem	QA/QC Measure	Corrective Action
	of this study step with the SAP	field audit.
Verbal Interview		
Incorrect completion of field form (IFF) from verbal interview	Field team orientation	Reorientation of IFF and interview procedures.
	Field form completion checks	Reorientation of IFF completion procedures and additional checks of IFFs completed by the same team. Resubmit IFFs requiring correction to Volpe Center for revised data entry.
	Screening field checks	Reorientation of IFF completion procedures and additional checks of IFFs completed by the same team. Resubmit IFFs requiring correction to Volpe Center for revised data entry.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Soil Sampling		
Incorrect completion of field form (FSDS) for sample collection	Field team orientation	Reorientation of FSDS completion procedures.
	Field form completion checks	Reorientation of FSDS completion procedures and additional checks of FSDSs completed by the same team. Resubmit FSDSs requiring correction to Volpe Center for revised data entry.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Incorrect completion of field logbook	Field team orientation	Reorientation of field logbook completion procedures.
	Field form completion checks	Reorientation of logbook completion procedures and additional checks of logbooks completed by the same team.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Incorrect completion of COC	Field team orientation	Reorientation of COC completion procedures.
	Field form completion checks	Reorientation of COC completion procedures and additional checks on COCs completed by the same team. Resubmit COCs requiring correction to Volpe Center for revised data entry and contact laboratory by fax or e-mail (to document the problem) and issue revised COC.
	Field audit to assess compliance	Implement corrective actions of

Potential Problem	QA/QC Measure	Corrective Action
	of this study step with the SAP	field audit.
Incorrect documentation of changes to study process	Screening field checks	Review process for documentation of changes to the study process and complete required documentation.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Incorrect decontamination procedures	Field Team Orientation	Reorientation of decontamination procedures.
	Field equipment blanks and rinsate samples	Reorientation of decontamination procedures and qualification of data as described by data validation procedures.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Incorrect recording of GPS locations	Field team orientation	Reorientation of GPS recording procedures.
	Screening field checks	Reorientation of GPS recording procedures.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Incorrect determination of sampling locations	Field team orientation	Reorientation of sample location selection process.
	Screening field checks	Reorientation of sample location selection process.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Incorrect sample collection techniques	Field team orientation	Reorientation of sample collection procedures.
	Field equipment blanks	Reorientation of decontamination procedures and qualification of data as described by data validation procedures.
	Field duplicates	Reorientation of sample collection procedures and qualification of data as described by data validation procedures.
	Preparation duplicates and laboratory equipment blank samples	Discussion with preparation laboratory regarding procedure. If consistent problems with the equipment blank occur, a laboratory audit may be performed.
	Field audit to assess compliance of this study step with the SAP	Implement corrective actions of field audit.
Incorrect packaging and COC	Field team orientation	Reorientation of COC

Potential Problem	QA/QC Measure	Corrective Action
during shipment of samples	Field audit to assess compliance of this study step with the SAP	procedures. Implement corrective actions of field audit.
Inadequate sample preparation procedures	Preparation duplicates and laboratory equipment blank samples	Discussion with preparation laboratory regarding procedure. If consistent problems, a laboratory audit may be performed.
Incorrect information entered into the database	Data entry checks	Notify the Volpe Center of errors and perform additional checks on data entered.

7.1.4 Sample Analysis

The data validation criteria for soil results are currently under development. Once the criteria are developed, the CSS SAP will be updated to include this information. The QA/QC measures associated with soil data validation are presented in the CSS SAP (CDM 2002a), but will be revised once data validation criteria for soil results are developed.

The QA/QC measures associated with this study process are discussed below followed by a detail of the potential problems with this study step, the QA/QC measures designed to mitigate the problems, and the corrective actions to prevent reoccurrence of problems.

Laboratory Training

A laboratory training program developed by the EPA will be implemented at the laboratories utilized to analyze samples for the CSS. The training will be for all analysts and new equipment.

Laboratory Audits

Laboratories utilized to analyze samples collected as part of the CSS will be required to provide proof of current certifications. Examples of certifications include the following: American Industrial Hygiene Association and NVLAP. If laboratory QC controls show consistent problems in the data validation process, a laboratory audit may be performed.

Data Entry Checks

Data entry into the Libby project database is performed by Volpe with a 100 percent QC of the data. CDM will perform an additional 10 percent QC on all data entered into the database by comparing field data sheets, survey forms, COCs, and analytical data. This check will be performed on a daily basis on the data entered from the previous day.

CDM Document Review Process

All project deliverables will receive technical and QA reviews prior to being issued to EPA. These reviews will be conducted in accordance with CDM's Quality Procedure (QP) 3.2 Technical Document Review and QP 3.3 Quality Assurance Review (CDM 1997). Completed review forms will be maintained in the project files. The potential problems and corrective actions associated with SEM/IR splits are presented below.

Potential Problem	QA/QC Measure	Corrective Action
Incorrect analytical results entered into the database	Data entry checks	Notify the Volpe Center of errors and perform additional checks on data entered.
Incorrect information in residential/owner followup letter	CDM document review process	Make corrections to document.

Every reasonable attempt will be made to obtain a complete set of usable analytical data. If a measurement cannot be obtained or is rejected for any reason, the CDM project manger and CDM QA staff will evaluate the effect of the missing data in a real-time manner such that appropriate corrective action can be taken.

7.2 Assessment and Oversight

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities. Assessment and oversight reports are discussed below.

7.2.1 Assessments and Response Actions

Performance assessments are quantitative checks on the quality of a measurement system and may be used for analytical work. System assessments are qualitative reviews of different aspects of project work to check on the use of appropriate QC measures and functioning of the QA system. When a project exceeds 1 year, an office system assessment is required.

Performance assessments for the laboratory may be accomplished by submitting reference material as blind reference (or performance evaluation) samples. These assessment samples are samples with known concentrations that are submitted to the laboratory without informing the laboratory of the known concentration. Samples will be provided to the laboratory for performance assessment upon request from the EPA RPM. Laboratory audits may also be conducted upon request from the EPA RPM. CDM will be responsible for tracking the quality of data received from laboratories by performing data validation. If during the data validation process consistent quality issues are discovered, CDM may recommend a laboratory audit be performed.

Response actions will be implemented on a case-by-case basis to correct quality problems. Minor response actions taken in the field to immediately correct a quality

problem will be documented in the applicable logbook and verbally reported to the CDM project manager. For verbal reports, the CDM project manager will complete a communication log to document that response actions were relayed to him. The CDM project manager and the EPA RPM will approve major response actions taken in the field prior to implementation of the change. Major response actions are those that may affect the quality or objective of the investigation. Quality problems that cannot be corrected quickly through routine procedures (i.e., those resulting from an audit or those that signify an adjustment to the planning documents resulting from the audit) require implementation of a Corrective Action Request (CAR) Form. Corrective action forms will be implemented in accordance with CDM's QP 8.1, Correction Action (CDM 1997).

All formal response actions will be submitted to either CDM's RAC Region VIII QA specialist or RAC regional QA coordinator for review and issuance. CDM's project manager or project QA coordinator will notify the QA manger or regional QA coordinator when quality problems arise that may require a formal response action.

7.2.2 Reports to Management

QA reports will be provided to management whenever quality problems are encountered. Field staff will note any quality problems in the field logbooks. CDM's project manager will inform the project QA coordinator upon encountering quality issues that cannot be immediately corrected. Monthly QA reports will be submitted to CDM's RAC Region VIII QA manager by the local QA coordinator and the RAC regional QA coordinator. Topics to be summarized regularly may include but not be limited to: technical and QA reviews that have been conducted, activities and general program status, project meetings, corrective action activities, any unresolved problems, assessment of data deficiencies, and any significant QA/QC problems not included above.

7.3 Reconciliation with Data Quality Objectives

Once data has been generated, CDM will evaluate that analytical data for data quality assessment and adherence to the DQOs.

Figure 7-1: Quality Control Associated with Each Step of the CSS Process (Field)

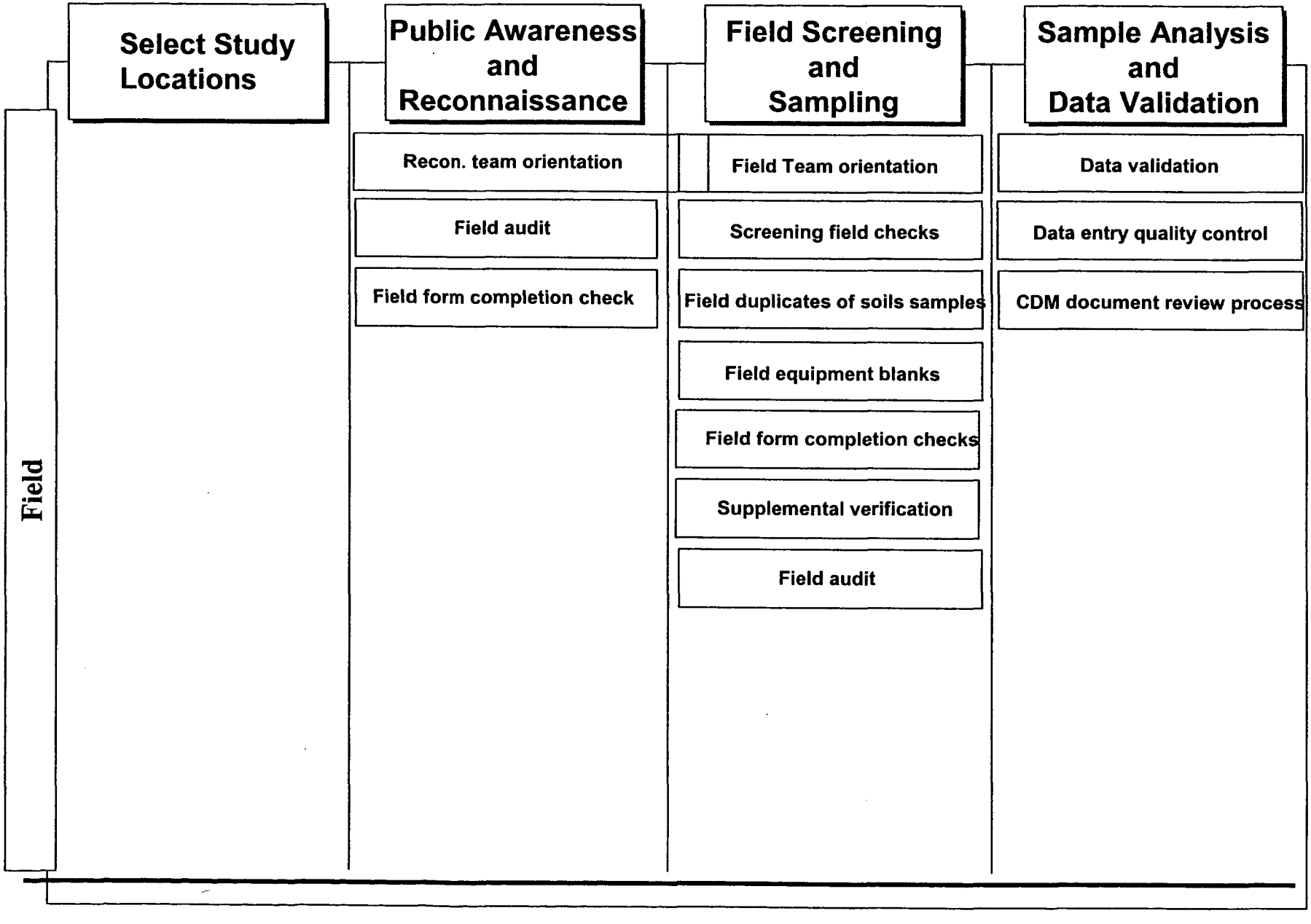
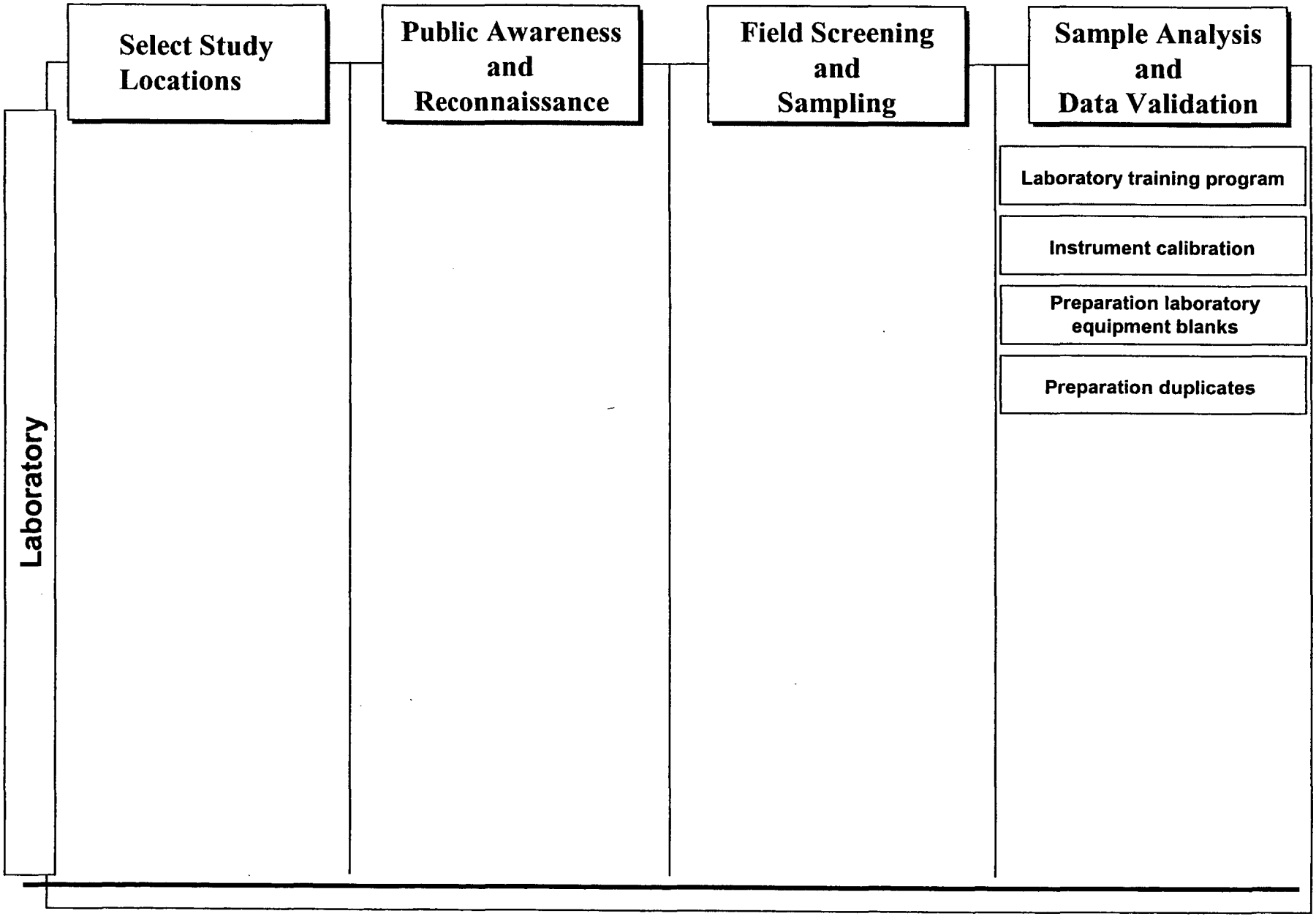


Figure 7-2: Quality Control Associated with Each Step of the CSS Process (Laboratory)



Section 8
References

ASTM. 1995. Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations. Designation D5755-95. October.

ASDR. 2001. Health Consultation, Libby Asbestos Site, Libby, Lincoln County, Montana. Mortality from Asbestosis in Libby, Montana, 1979 - 1998.

CDM. 1996. RAC Region VIII Quality Assurance Project Plan. August.

_____. 1997. Quality Assurance Manual, Part Two, Revision 8. October.

_____. 2002b. Original Work Plan for the Libby Asbestos Site, Operable Unit 4, Libby Asbestos Remedial Investigation Sampling and Analysis Plan and Supporting Activities, Libby, Montana. March.

_____. 2002c. Technical Standard Operating Procedures Manual. Revision 16.

_____. 2003a. Contaminant Screening Study Interim Results Report. April.

_____. 2003b. Sampling and Analysis Plan, Remedial Investigation. April.

_____. 2003c. Original Work Plan for Libby Asbestos Site, Operable Unit 4, Remedial Investigation Field Work and Support, Libby, Montana. April.

_____. 2003d. Soil Preparation Plan, Remedial Investigation, Contaminant Screening Study, Libby Asbestos Site, Operable Unit 4. April.

_____. 2003d. RAC Region VIII Quality Management Plan. August.

EPA. 1987. Asbestos-Containing Materials in Schools: Final Rule and Notice, Federal Register, 40 CFR Part 763, Appendix A to Subpart E. October.

_____. 2000a. Sampling and Quality Assurance Project Plan for Libby, Montana, Environmental Monitoring for Asbestos. Revision 1. January.

_____. 2000b. Guidance for the Data Quality Objectives Process, EPA QA/G-4. Final. August.

_____. 2000c. Asbestos Analysis of Soil by Scanning Microscopy and Energy Dispersive X-Ray Spectroscopy. Revision 0. May 6, 2002.

_____. 2000d. Action Memorandum. Request for a Time Critical Removal Action Approval and Exemption from the 12-month, $2-million Statutory Limit at the Libby Asbestos Site-Export Plant & Screening Plant former Processing Areas, Libby Lincoln County, Montana. May 23, 2000.

_____. 2001a. Chris Weis Memorandum to Paul Peranard. Subject: Amphibole Mineral Fibers in Source Materials in Residential and Commercial Areas of Libby Pose an Imminent and Substantial Endangerment to Public Health. December 20, 2001.

_____. 2001b. EPA Requirements for Quality Assurance Project Plans, QA/R-5. Final. March.

_____. 2001c. Action Memorandum. Request for a Time Critical Removal Action Approval and Exemption from the 12-month, $2-million Statutory Limit Libby Vermiculite Mine, Libby, Montana - Transmittal Memo. August 13, 2001.

_____. 2002. Action Memorandum Amendment for the Time-Critical Removal Action at the Libby Asbestos Site - Libby, Lincoln County, Montana. May.

ISSI. 2000. Project Plan for the Asbestos in Soil Performance Evaluation Study. Libby Asbestos Site, Libby Montana. Part A - Collection of Soil and Asbestos Materials. June 2, 2000.

Leake, B.E., et al. 1997. Nomenclature of Amphiboles: Report of the Subcommittee on Amphiboles of the International Mineralogical Association, Commission on New Mineral and Mineral News. American Mineralogist: 82.

Natural Resource Conservation Service (NRCS). 1998. Soil Survey of the Kootenai National Forest Area. Soil Survey Staff. September.

NIOSH. 1994. Asbestos (bulk) by PLM. Method 9002, Issue 2. August.

SRC 2003a. Quality Assurance Project Plan for Libby Montana. Performance Evaluation Study for Analytical Methods for Asbestos in Soil. Part B, Revision 1 - Preparation of Performance Evaluation Samples. January 24, 2003.

SRC 2003b. Quality Assurance Project Plan for the Asbestos in Soil Performance Evaluation Study. Libby Asbestos Site, Libby Montana. Part C - Round-Robin Analysis of Performance Evaluation Samples. Draft. April, 2003.

Appendix A

SRC Technical Memorandums

TECHNICAL MEMO 1

Concordance Between Visible Vermiculite and the Occurrence of Asbestos by PLM in Soil and Soil-Like Media

TECHNICAL MEMO 2

Occurrence of Asbestos in Libby Vermiculite Insulation

TECHNICAL MEMO 3

Evaluation of the Need for Indoor Dust Sampling at Buildings in Libby Where Vermiculite Insulation is Present

TECHNICAL MEMO 1

CONCORDANCE BETWEEN VISIBLE VERMICULITE AND THE OCCURRENCE OF ASBESTOS BY PLM IN SOIL AND SOIL-LIKE MEDIA

1.0 INTRODUCTION

USEPA Region 8 is currently planning a large-scale investigation to identify potentially significant sources of asbestos in and about the community of Libby. Because of the cost and time required to perform a microscopic analysis of each potential source material, EPA wished to evaluate the reliability of the assumption that when visible vermiculite was present in a sample of soil-like media that asbestos would be observable by polarized light microscopy (PLM) in that sample. This technical memo summarizes the data bearing on that question.

2.0 APPROACH

A query of the Libby database was performed on 05/03/02. All samples of soil or soil-like media (this does not include insulation) were reviewed to determine if the word "vermiculite" occurred in the comment field. A query was designed to isolate those samples in which the comment indicated that vermiculite was visible by eye, and all such samples were then classified into four bins according to the results of an analysis for asbestos by PLM:

- No PLM results available
- Non-detected
- Trace (asbestos visible by PLM, but level is too low to provide a quantitative estimate)
- Quantifiable ($\geq$ 1% asbestos by mass)

The design of the query and the resulting output are provided as Attachment 1.

3.0 RESULTS

A total of 568 soil or soil-like samples were located in which the comment field indicated that visible vermiculite was present. Of these, PLM results were available for 567. These PLM results are summarized below:

PLM Result	Number of Samples	Percent of Total
Non-detect	145	26%
Trace	303	53%
Quantifable (≥ 1%)	119	21%

As see, 74% of the samples had detectable (trace or higher) levels of asbestos present, with 21% being above the quantitation limit (about 1%). This indicates that most samples with visible vermiculite also contain asbestos by PLM.

Samples of soil and soil-like media containing visible vermiculite have been collected from a wide variety of locations around the Libby site. In order to determine if the frequency of detectable asbestos in samples with visible vermiculite depends on the land use category, the samples were stratified into four bins, as shown in Table 1. As seen, the frequency of PLM-detectable asbestos in to soil samples is 70% or greater in all cases, supporting the conclusion that the association of asbestos with visible vermiculite is not a function of land use category.

In order to determine if these is any spatial pattern to the occurrence of vermiculite and asbestos in soil, several maps (Figure 1A, 1B, 1C, 1D) were prepared to show the location of soil samples that contained visible vermiculite[1], color-coded to indicate the results of the PLM analysis for asbestos (blue = ND, orange = trace, red = 1% or greater). As shown in Figure 1C, a majority of the samples that contained 1% asbestos were located at the screening plant. This is perhaps expected, since soil at this site was generally more heavily contaminated with vermiculite than at most other locations. In the residential and commercial area of Libby, no clear pattern of occurrence of asbestos level was apparent.

4.0 CONCLUSION

Based on the high concordance between the occurrence of visible vermiculite in soil and soil-like media and the presence of detectable (trace or quantifiable) levels of asbestos fibers by PLM, it is concluded that the presence of visible vermiculite in soil at the Libby site is a reliable and useful indicator of the presence of elevated levels of asbestos.

[1] Not all locations with visible vermiculite in soil are shown in the maps, since coordinates are not availablr for all sampling locations.

Table 1. Summary of PLM Results for Soil and Soil-Like Media with Visible Vermiculite Present

PLM Result	Screening/Export		Schools		Residential/Commercial		Landfill	
	Number of Samples	Percent of Total	Number of Samples	Percent of Total	Number of Samples	Percent of Total	Number of Samples	Percent of Total
Non-detect	2	3%	5	19%	135	30%	3	21%
Trace(<1%)	18	25%	9	35%	265	58%	11	79%
Quantifable (≥ 1%)	52	72%	11	42%	56	12%	0	0%

Color Map(s)

The following pages contain color that does not appear in the scanned images.

To view the actual images, please contact the Superfund Records Center at (303) 312-6473.

Libby, Montana

Locations of Soils With Visible Vermiculite

Figure 1A

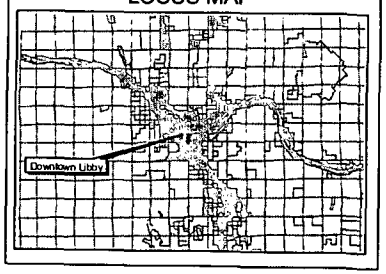
Asbestos Levels In Soil (by PLM)

Soil Sample Results

- $ ND
- S TRACE
- $ ≥1%

Approximate Parcel Boundaries

LOCUS MAP

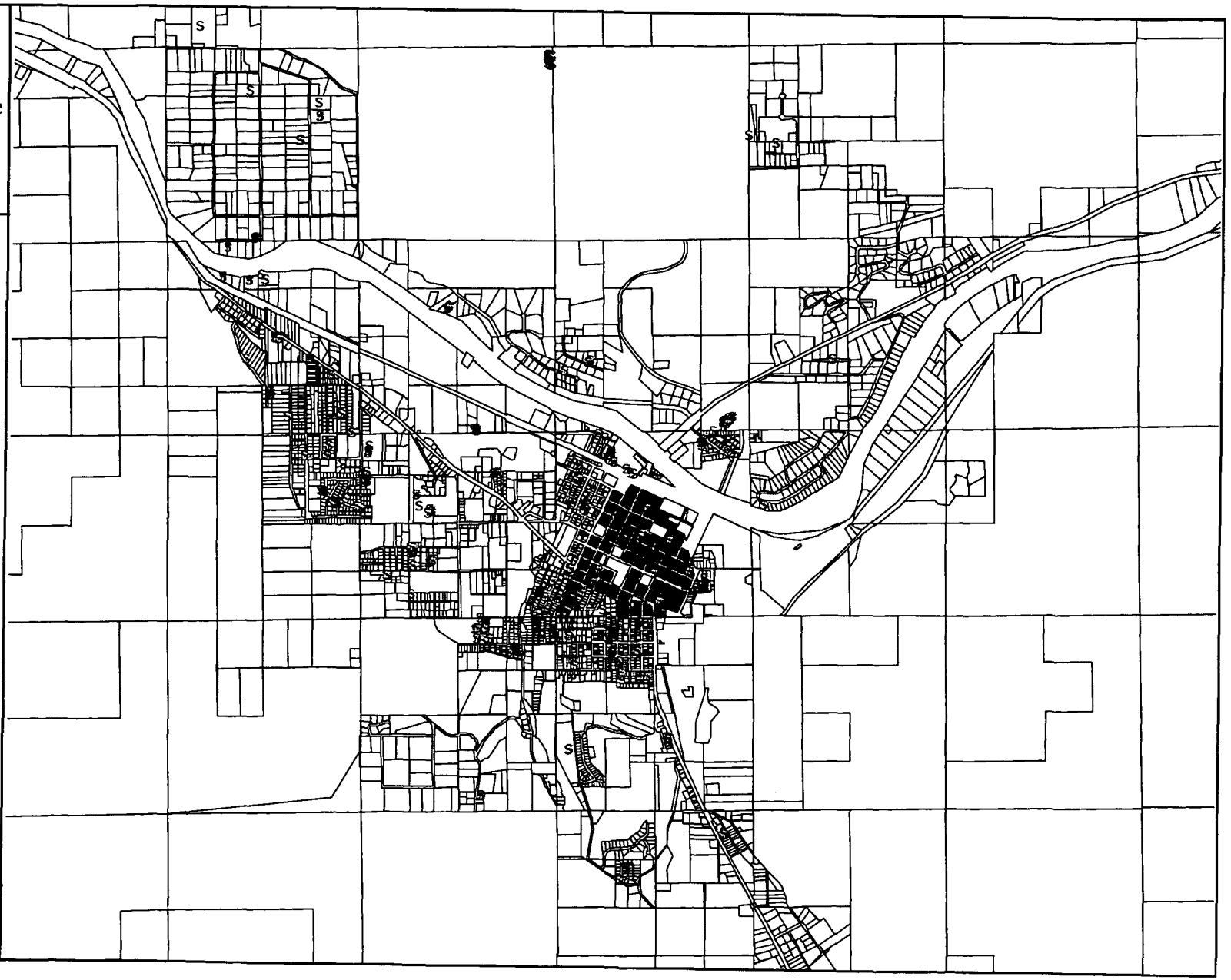


May, 2002

Map Projection UTM Zone 11 NAD83 FT

CDM

2500 0 2500 Feet



Libby, Montana

Locations of Soils With Visible Vermiculite

Figure 1B

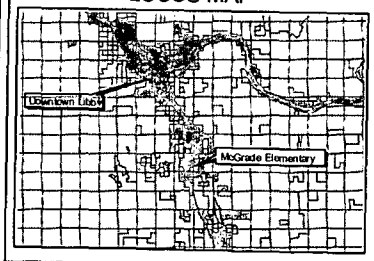
Asbestos Levels In Soil (by PLM)

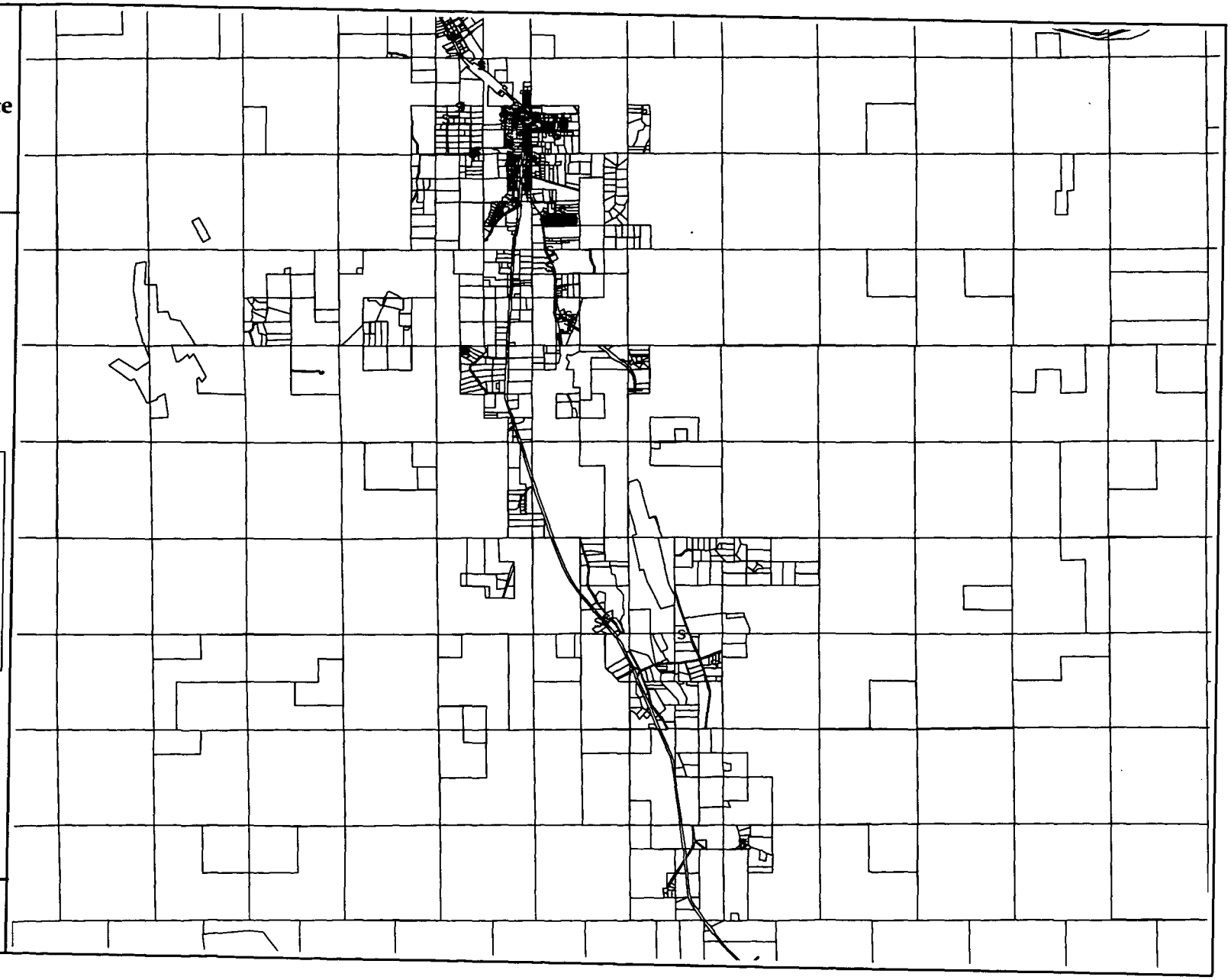
Soil Sample Results

- S ND
- S TRACE
- S ≥1%

Approximate Parcel Boundaries

LOCUS MAP





May, 2002

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Map Projection UTM Zone 11 NAD83 FT

CDM

5000 0 5000 Feet

Libby, Montana

Locations of Soils With Visible Vermiculite

Figure 1C

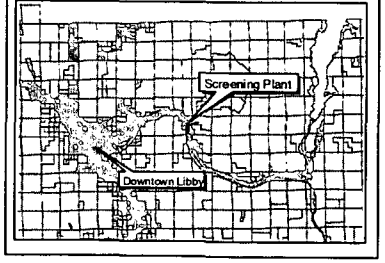
Asbestos Levels In Soil (by PLM)

Soil Sample Results

- $ ND
- S TRACE
- $ ≥1%

Approximate Parcel Boundaries

LOCUS MAP



May, 2002

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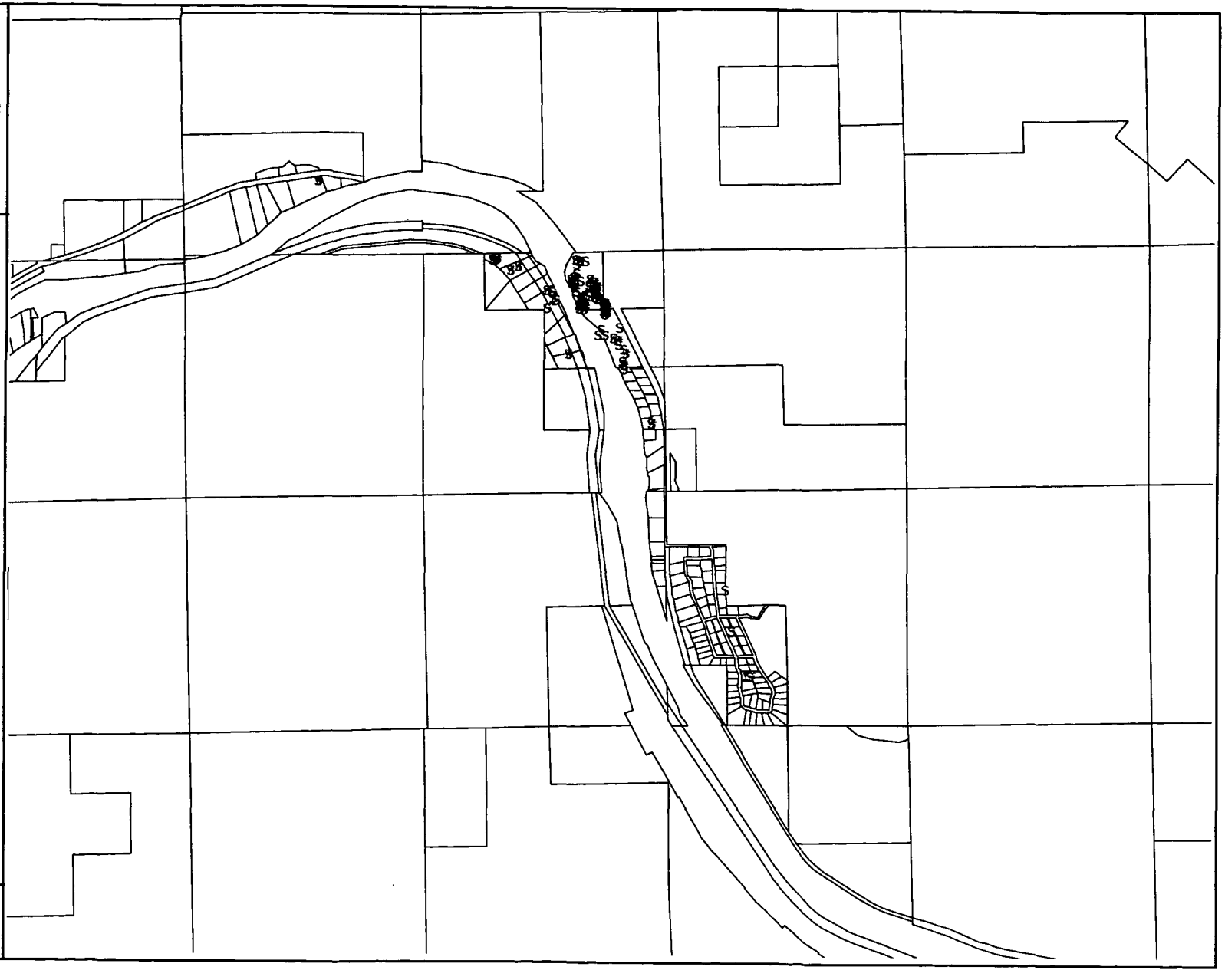
Map Projection UTM Zone 11 NAD83 FT

CDM

2000 0 2000 Feet



Libby, Montana

Locations of Soils With Visible Vermiculite

Figure 1D

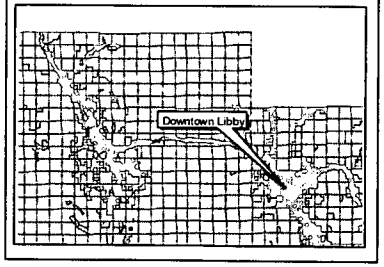
Asbestos Levels In Soil (by PLM)

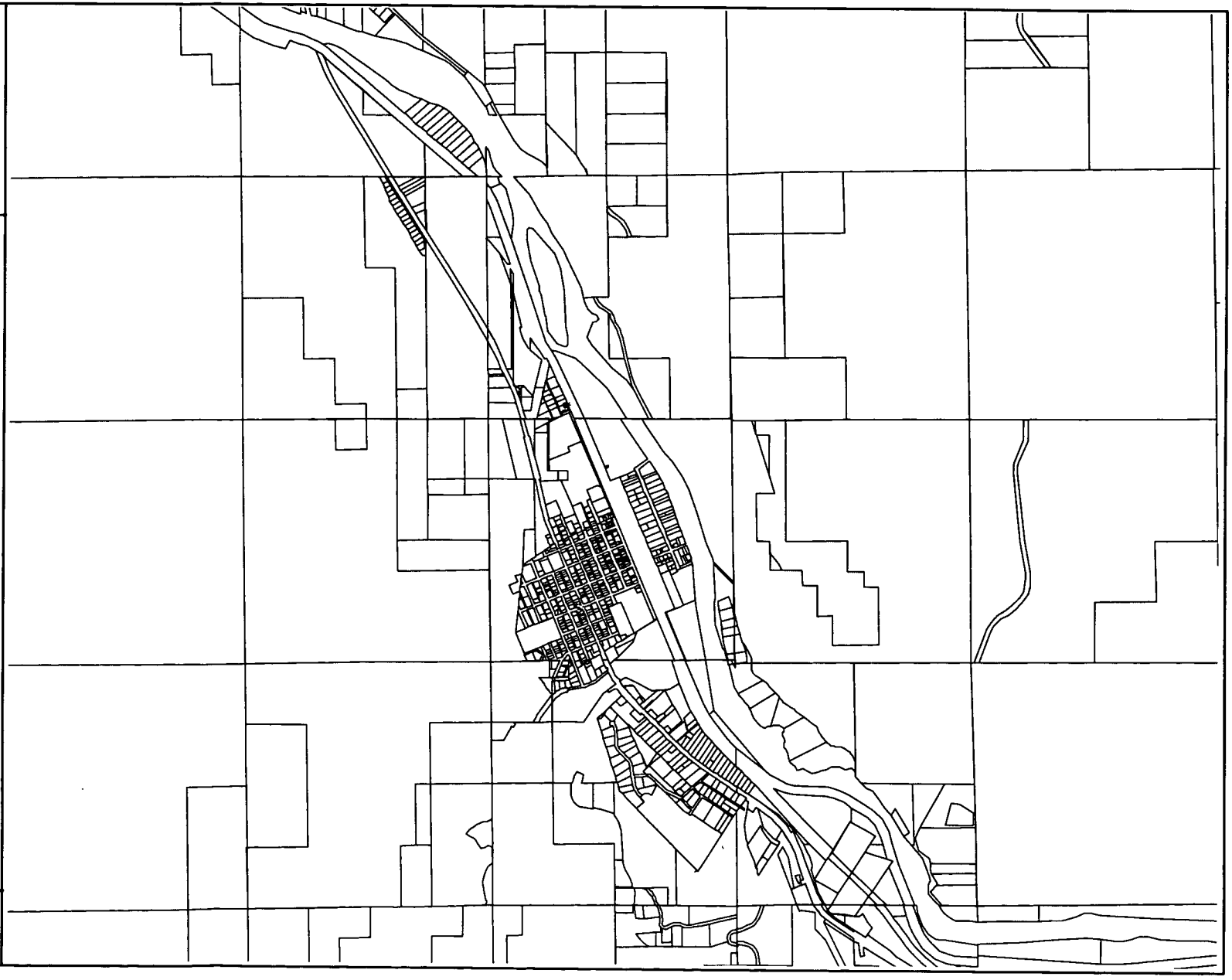
Soil Sample Results

- ND
- TRACE
- ≥1%

Approximate Parcel Boundaries

LOCUS MAP





May, 2002

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Map Projection UTM Zone 11 NAD83 FT

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TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2009683

SITE NAME: LIBBY ASBESTOS

DOCUMENT DATE: 05/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX A
TECHNICAL MEMO 1
Attachment 1 Data

Contact the Superfund Records Center to view available document.
(303) 312-6473

TECHNICAL MEMO 2

OCCURRENCE OF ASBESTOS IN LIBBY VERMICULITE INSULATION

1.0 INTRODUCTION

USEPA Region 8 is currently planning a large-scale investigation to identify potentially significant sources of asbestos in and about the community of Libby. Available data from the site support the conclusion that Libby vermiculite insulation (LVI) contains asbestos fibers, and that disturbance of the LVI can lead to release of asbestos fibers into air (Weis 2001a, 2001b). Thus, LVI is one of the sources of chief public health concern to EPA at the Libby site.

Because of the cost and time required to perform a microscopic analysis of each LVI sample, EPA wished to assess the reliability of the assumption that all samples of LVI should be considered a potential source of asbestos fibers. This technical memo summarizes the data bearing on that question.

2.0 APPROACH

A query of the Libby database was performed on 05/03/02 to isolate all samples that were classified as "insulation". These samples were classified into four bins according to the results of an analysis for asbestos by polarized light microscopy (PLM):

- No PLM results available
- Non-detected
- Trace (asbestos visible by PLM, but level is too low to provide a quantitative estimate)
- Quantifiable ($\geq$ 1% asbestos by mass)

The design of the query and the resulting output are provided as Attachment 1.

3.0 RESULTS

A total of 126 insulation samples were located. Of these, 125 had results of an analysis by PLM. These results are summarized below:

PLM Result	Number of Samples	Percent of Total
Non-detect	33	26%
Trace	84	67%
Quantifable (≥ 1%)	8	6%

As see, 74% of the insulation samples had detectable (trace or higher) levels of asbestos present, with 6% being above the quantitation limit.

In order to determine if there is any spatial pattern to the occurrence of LVI and the occurrence of detectable asbestos in the insulation, a series of maps (Figures 2A, 2B, 2C) were prepared to show the location of LVI samples that have been collected[1], color coded to indicate the results of the PLM analysis (blue- non-detect, orange = trace, red = 1% or higher). Inspection of these maps does not reveal any clear spatial pattern, either for the occurrence of LVI, or for the level of asbestos reported in the LVI.

4.0 CONCLUSION

Based on the high fraction of LVI samples from the Libby site that contain detectable levels of asbestos by PLM, coupled with the evidence that disturbance of LVI leads to the release of asbestos fibers into air (Weis 2001a, 2001b), it is concluded that it is reasonable and appropriate to assume that LVI at the Libby site is a probable source of asbestos fibers, and that individual analysis of each sample of LVI is not necessary or cost effective to make decisions regarding the potential risk from this material at this site.

5.0 REFERENCES

Weis, C.P. 2001a. Fibrous Amphibole Contamination in Soil and Dust at Multiple Locations in Libby Poses an Imminent and Substantial Endangerment to Public Health: an Addendum to my Memorandum of May 10, 2000. Memorandum from Christopher P. Weis, USEPA Regional Toxicologist, to Paul Peronard, USEPA On-Scene Coordinator for the Libby Asbestos Site. Dated 07/11/2001.

Weis, C.P. 2001b. Amphibole Mineral Fibers in Source Materials in Residential and Commercial Areas of Libby Pose an Imminent and Substantial Endangerment to Public Health. Memorandum from Christopher P. Weis, USEPA Regional Toxicologist, to Paul Peronard, USEPA On-Scene Coordinator for the Libby Asbestos Site. Dated 12/18/2001.

[1] Not all samples of LVI are shown on the maps because coordinate information is not available for all samples.

Libby, Montana

Locations of Buildings With Libby Vermiculite Insulation

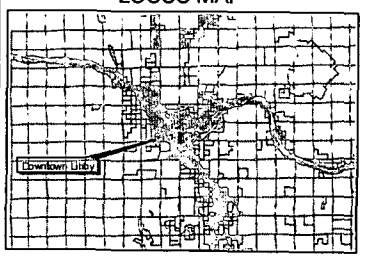
Figure 1A

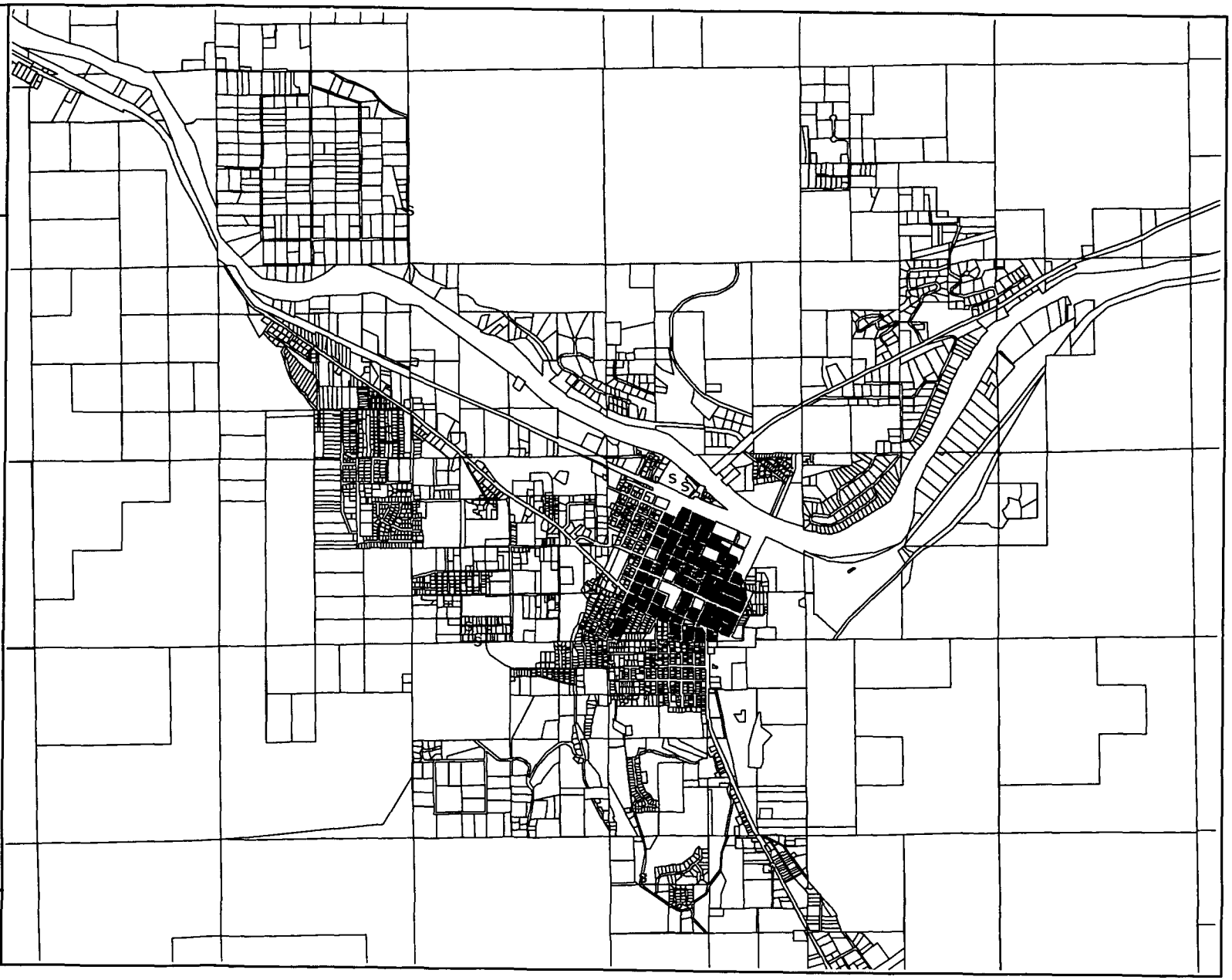
Soil Sample Results

- S ND
- S TRACE
- S ≥1%

Approximate Parcel Boundaries

LOCUS MAP





May, 2002

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Map Projection UTM Zone 11 NAD83 FT

CDM

2500 0 2500 Feet

Libby, Montana

Locations of Buildings With Libby Vermiculite Insulation

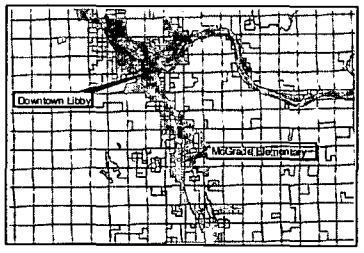
Figure 1B

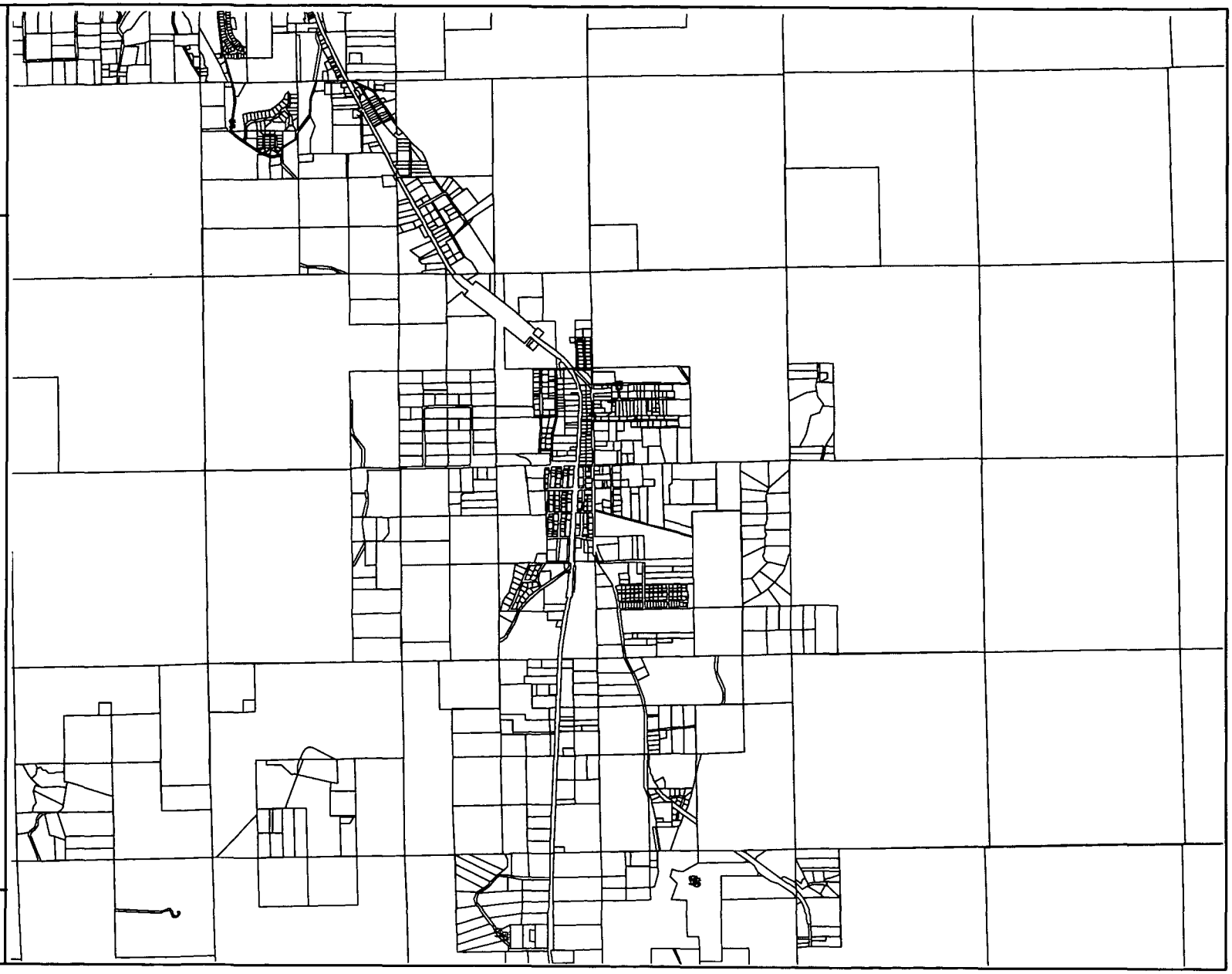
Soil Sample Results

- ND
- TRACE
- ≥1%

Approximate Parcel Boundaries

LOCUS MAP





May, 2002

N
W E
S

Map Projection UTM Zone 11 NAD83 FT

CDM

2500 0 2500 Feet

Libby, Montana

Locations of Buildings With Libby Vermiculite Insulation

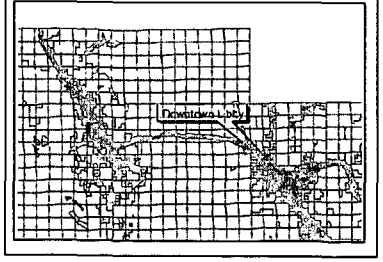
Figure 1C

Soil Sample Results

- ND
- TRACE
- ≥1%

Approximate Parcel Boundaries

LOCUS MAP

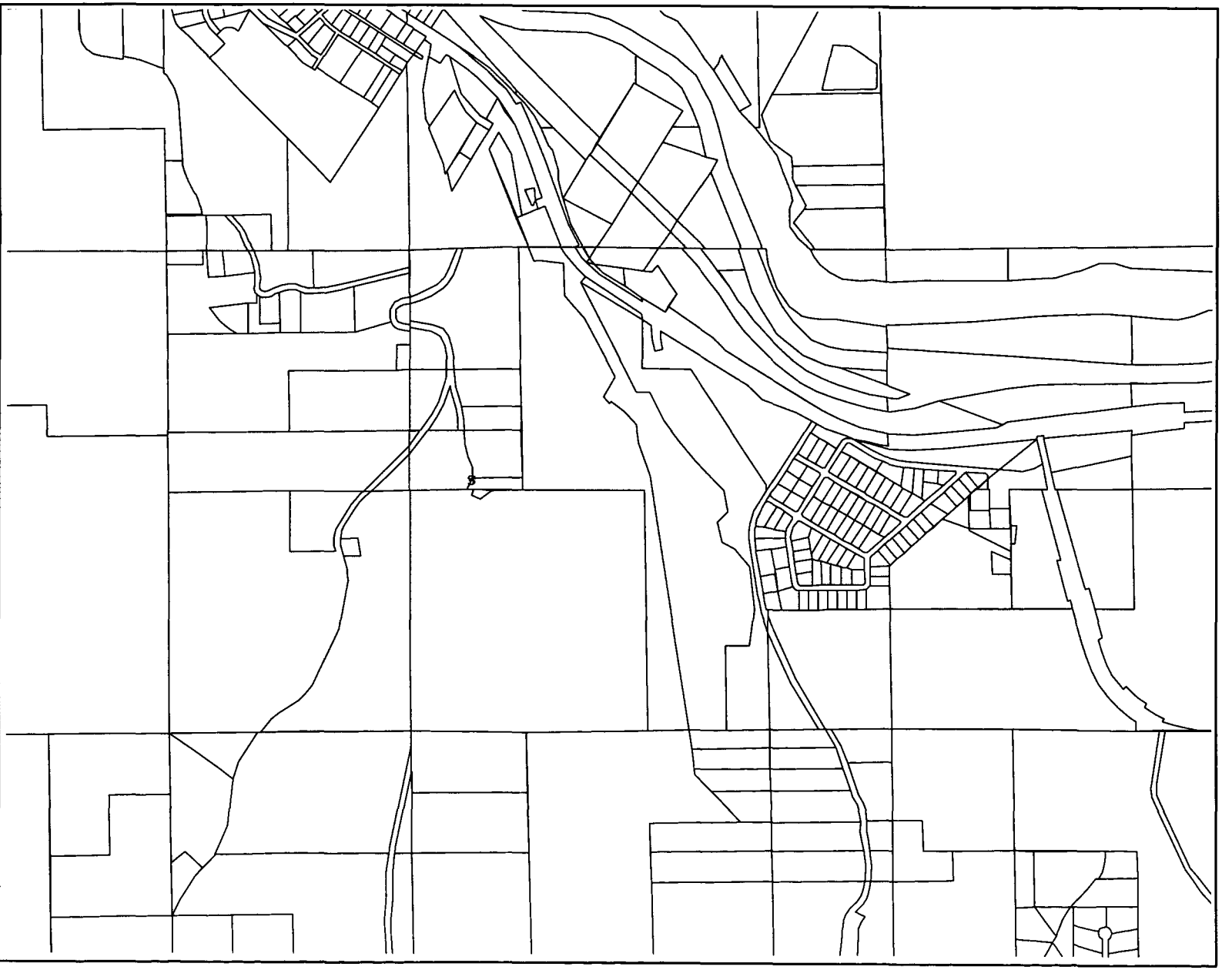


May, 2002

Map Projection UTM Zone 11 NAD83 FT

CDM

1000 0 1000 Feet



TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2009683

SITE NAME: LIBBY ASBESTOS

DOCUMENT DATE: 05/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX A
TECHNICAL MEMO 2
Attachment 1 Data

Contact the Superfund Records Center to view available document.
(303) 312-6473

TECHNICAL MEMO 3

EVALUATION OF THE NEED FOR INDOOR DUST SAMPLING AT BUILDINGS IN LIBBY WHERE VERMICULITE INSULATION IS PRESENT

1.0 INTRODUCTION

USEPA Region 8 is currently planning a large-scale investigation to identify potentially significant sources of asbestos in and about the community of Libby. One of the sources of concern to EPA is Libby vermiculite insulation (LVI). This material has been shown to be capable of releasing relatively high concentrations of asbestos fibers into air when disturbed (Weis 2001a, 2001b, Grace 1976).

A second medium of potential concern at a building with LVI is indoor dust. This is because any asbestos fibers that have been released from the LVI or other sources may become entrained in indoor dust, and the dust may serve as a secondary source even after the primary source (e.g., the LVI) has been removed or contained.

Because of the cost and time required to perform a microscopic analysis of dust samples at each building where LVI is found to be present, EPA wished to consider whether it was reasonable to assume that dust at such a location might be a potential secondary source, and take steps to remove the dust without the need for sampling. This technical memo presents an assessment of the pros and cons of that approach.

2.0 DATA SUMMARY

A query of the Libby database was performed on 05/03/02. First, a list of all samples of vermiculite insulation was prepared, and a list was prepared of the addresses of the locations where these samples were collected. Next, a list of all dust samples that were collected at any of the same locations (i.e., at buildings with LVI present) was prepared. Finally, the results of transmission electron microscopy (TEM) examination of these dust samples were tabulated and classified into two bins (detect or non-detect). Detects were defined as samples in which one or more Libby-class amphibole fibers were observed that had either a) an aspect ratio $\geq$ 5:1, thickness $\leq$ 0.5 um and length $\geq$ 5 um, or b) an aspect ratio $\geq$ 5:1 and thickness > 0.5 um. These dimensions were used because they include the size range suspected to be of greatest potential human health concern. Samples were assigned to the "Non-detect" bin if they did not contain one or more of the fibers above (even if Libby-class amphibole fibers were observed

outside these size bins).

The design of the query and the resulting outputs are provided as Attachment 1. The results are summarized below:

TEM Result	Number of Dust Samples	Percent of Total
Non-detect	230	75%
Detect	75	25%
Total	305	100%

3.0 DISCUSSION

As seen, about 25% of the dust samples collected at locations with LVI had observable levels of Libby class amphibole fibers. Superficially, this would suggest that cleaning up indoor dusts at all locations with LVI might not be necessary in a number of cases, and that testing of dust before cleaning might be appropriate.

However, there are several reasons why the testing of all dusts may not be necessary or effective at this site. First, the detection limits for asbestos fibers in dust samples from the site are generally in the range of 250-300 f/cm^2, with a number of detection limit values in excess of 1,000 f/cm^2 (depending on the number of grids examined and the relative level of debris in the sample). Thus, in many cases, a non-detect result is not strong evidence that no fibers are actually present.

Second, even in the case that the LVI in a building has not released any fibers into indoor dust, fibers might be released to dust as a consequence of the LVI removal activity. While EPA will seek to prevent the release of asbestos fibers from LVI into the remainder of the building during removal activities, the possibility of some fiber contamination cannot be totally excluded. Because of this, EPA will perform a "clearance test" at the end of each LVI removal to establish that it is safe for the occupants of the building to re-enter the space. Because the occupants of the building must be absent from the premises until this test has been completed, there is a premium on the most time-effective approach for determining if re-entry is permissible. If the procedure for establishing clearance required collection and analysis of dust samples before a decision could be made as to whether dust removal was needed, the time before clearance testing would be extended by the length of time needed to collect and analyze the dust sample. This period of time will vary, but not likely to average less than about 3 days. Conversely, if EPA simply performed a dust cleaning immediately upon completion of the LVI removal, and

followed this by the clearance test, clearance could be achieved in 1-2 days.

Finally, the incremental cost of performing automatic dust cleanups without prior testing are not expected to be substantial compared to the cost of testing before dust removal. The estimated relative costs are compared in the following table:

Activity	Cost per 100 Buildings	
	Option 1 Test dust before cleanup	Option 2 Cleanup dust without test
Dust collection (a)	$62,500	$0
Dust analysis (b)	$140,000	$0
Dust cleanup (c)	$225,000	$450,000
Total cost	$427,500	$450,000

(a) Assumes 3 composite samples and one blank per location

(b) Assumes 25 grid openings counted per sample

(c) Assumes that 50% of post remediation dust samples contain asbestos, indicating the need for dust removal before clearance

4.0 CONCLUSIONS

Based on a consideration of the long turnaround time before clearance if dust testing is required as well as the uncertainty associated with a non-detect in dust, it is concluded that it is reasonable and appropriate to perform an indoor dust removal at all homes in Libby that undergo LVI removal, and that this step is not contingent upon testing the dust for asbestos contamination. Any increment in cost (about 5% of the total cost) for Option 2 are more than justified by the decreased delay in allowing re-entry of building occupants, and will be partially or entirely defrayed by reduced per diem costs.

5.0 REFERENCES

Grace, W.R.. 1976. Controlled Drop Air Sampling, July 23. Memo to HA Brown et al. Dated August 5, 1976. (103Z00768).

Weis, C.P. 2001a. Fibrous Amphibole Contamination in Soil and Dust at Multiple Locations in Libby Poses an Imminent and Substantial Endangerment to Public Health: an Addendum to my Memorandum of May 10, 2000. Memorandum from Christopher P. Weis, USEPA Regional Toxicologist, to Paul Peronard, USEPA On-Scene Coordinator for the Libby

Asbestos Site. Dated 07/11/2001.

Weis, C.P. 2001b. Amphibole Mineral Fibers in Source Materials in Residential and Commercial Areas of Libby Pose an Imminent and Substantial Endangerment to Public Health. Memorandum from Christopher P. Weis, USEPA Regional Toxicologist, to Paul Peronard, USEPA On-Scene Coordinator for the Libby Asbestos Site. Dated 12/18/2001.

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2009683

SITE NAME: LIBBY ASBESTOS

DOCUMENT DATE: 05/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

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DOCUMENT DESCRIPTION:

APPENDIX A
TECHNICAL MEMO 3
Attachment 1 Data

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Appendix B

Site Health and Safety Plan

Health and Safety Plan Form	Environmental Protection Agency -- Region 8 --	CDM Federal Programs Corporation Project Document No.: 3282-137-PP-HASP

Project Name	Libby Asbestos Superfund Site OU4	**Work Assignment No.**	137-RIRI-08BC **Region** 8
Job Site Address	All properties within Libby Valley, encompassing	**Client**	U. S. Environmental Protection Agency
	Approx. 192 sq. miles including the City of Libby and areas where Libby amphibole asbestos contamination has historically been found. This sampling effort is designed to investigate all properties within the Libby Valley and will include a verbal and visual investigation. CDM project office: 318 Louisiana Ave, Libby, Montana 59923	**Project**	Libby Asbestos RI OU4 - Contaminant Screening Study
Site Contact	Dave Schroeder	**EPA Client Contact**	Jim Christiansen, EPA RPM
Phone No.	406-293-8595 or 406-293-3388	**Phone No.**	303-312-6748

■ **Amendment No.** 1 **to Existing Approved HSP - Date Existing Approved HSP** 4/1/02

Objectives of Field Work:

The purpose of this sampling effort is to collect information to fill data gaps and to determine if properties require remediation. Data obtained for this investigation will include attic inspections, building material inspections, dust sampling, and onsite soil sampling from suspected contaminated areas. Results of this investigation will be used to facilitate any immediate removal actions deemed necessary by the EPA and for future project management decisions.

Type: Check as many as applicable

☐ Active	☐ Landfill	☐ Unknown
■ Inactive	■ Uncontrolled	☐ Military
■ Secure	■ Industrial	■ Other **specify:**
■ Unsecure	☐ Recovery	Since this RI will occur on all properties in the Libby Valley, facility types will vary greatly.
☐ Enclosed space	☐ Well Field	

Description and Features: Summarize below. Include principal operations and unusual features (containers, buildings, dikes, power lines, hills, slopes, river)

The Town of Libby is located in the extreme northwest corner of Montana. According to historical mining records, 80 percent of the world's vermiculite came from the Zonolite Mountains in Libby, Montana. EPA has determined that the vermiculate ore that was mined from these mountains is contaminated with Libby amphibole asbestos. This ore was shipped throughout the United States both as processed and unprocessed material. EPA has been conducting various investigations to determine potentially contaminated properties within Libby, which may have resulted from the Libby mining operations. This amphibole asbestos is suspected of affecting the health of the residents at various sites from numerous locations. The properties associated with this investigation may be contaminated with Libby amphibole asbestos from introduced sources. Properties include residential and small commercial areas and vary in size. Potential source materials include attic insulation and contaminated soils.

Surrounding Population: ■ Residential ■ Industrial ■ Rural ■ Urban ☐ Other:

This Page Reserved for Map (Show Exclusion, Contamination Reduction, and Support Zones. Indicate evacuation and reassembly points.)

See Figures 2-2 in SAP text.

History: Summarize below. In addition to history, include complaints from public, previous agency actions, known exposures or injuries, etc.

The Zonolite Mine began operation in 1924 by owner Edward Alley. In 1925, Great Northern Railroad shipped the first boxcar of "Zonolite" from Libby to an Ohio company that used it to insulate bank vaults, office safes, and filing cabinets. Other firms used the material to make building boards and roofing materials. Processing the material was a straightforward process. The vermiculite ore was stripped from the mine and hauled in trucks to a mill, where it was separated into various commercial sizes through a screening system. Some of the ore was shipped unprocessed. Other material was sent to an expansion plant where it was processed in ovens at about 2,000 degrees, causing it to expand to 15 times its original size. In 1939, Zonolite merged with another company mining at the bottom of the hill that eventually became known as the Zonolite Co. In 1963, the company was sold to W.R. Grace and Co. who expanded the operation and increased production. Through the 60s, 70s, and 80s, millions of tons of vermiculite ore was hauled by rail to Grace plants and other companies in 30 states and 6 foreign countries. At one time, 80 percent of the world's vermiculite came from Libby. The W.R. Grace Company, which owned the mine for 30 years, closed it in 1990 and sold the property 4 years later.

Waste Types: ☐ Liquid ■ Solid ☐ Sludge ☐ Gas ☐ Unknown ☐ Other **Specify**:

Waste Characteristics: Check as many as applicable.

☐ Corrosive	☐ Flammable	☐ Radioactive*
■ Toxic	☐ Volatile	☐ Reactive
☐ Inert Gas	☐ Unknown	■ Other **specify**: Carcinogenic

Work Zones: Describe the Exclusion, Contamination Reduction, and Support Zones in terms onsite personnel will recognize.

Work zones will be used during intrusive attic inspections and soil sampling. The exclusion zone will be areas in close proximity to the intrusive work zone or soil sampling areas. The contamination reduction zone will be demarcated by the decontamination station set up at each sampling site. The support zone will be considered the 10-foot perimeter around support vehicles.

Hazards of Concern:

■ Heat Stress attach guidelines	☐ Noise:
■ Cold Stress attach guidelines	☐ Inorganic Chemicals
☐ Explosive/Flammable	☐ Organic Chemicals
☐ Oxygen Deficient	■ Motorized Traffic
☐ Radiological	☐ Heavy Machinery:
■ Biological: stinging insects, venomous reptiles	■ Slips, Trips, and Falls

■ Other **Specify**: Inhalation of particulate matter

Principle Disposal Methods and Practices: Summarize below:

The unused or below-grade material was disposed of by throwing it in piles around the facility. According to the previous site visit, there were no visible stockpiles of product that still exists.

Hazardous Material Summary: Circle waste type and estimate amounts by category

Chemicals Amounts/Units:	*Solids Amounts/Units:*	*Sludges Amounts/Units:*	*Solvents Amounts/Units:*	*Oils Amounts/Units:*	*Other Amounts/Units:*
☐ Acids	☐ Flyash	☐ Paint	☐ Halogenated (chloro, bromo)	☐ Oily Wastes	☐ Laboratory
☐ Pickling Liquors	■ Asbestos	☐ Pigments	☐ Solvents	☐ Gasoline	☐ Pharmaceutical
☐ Caustics	☐ Milling/Mine Tailings	☐ Metal Sludges	☐ Hydrocarbons	☐ Diesel Oil	☐ Hospital
☐ Pesticides	☐ Ferrous Smelter	☐ POTW Sludge	☐ Alcohols	☐ Lubricants	☐ Radiological
☐ Dyes/Inks	☐ Non-ferrous Smelter	☐ Aluminum	☐ Ketones	☐ PCBS	☐ Municipal
☐ Cyanides	☐ Metals:	☐ Distillation Bottoms	☐ Esters	☐ Polynuclear Aromatics	☐ Construction
☐ Phenols			☐ Ethers		☐ Munitions
☐ Halogens	☐ Other	☐ Other	☐ Other	☐ Other	☐ Other
☐ Dioxins	**Specify:**	**Specify:**	**Specify:**	**Specify:**	**Specify:**
☐ Other					
Specify:					

Overall Hazard Evaluation: ☐ High ☐ Medium ■ Low ☐ Unknown (Where tasks have different hazards, evaluate each. Attach additional sheets if necessary)

Justification: CDM personnel will avoid unnecessarily agitating suspect materials and visibly dusty conditions.

Fire/explosion Potential: ☐ High ☐ Medium ■ Low ☐ Unknown

Background Review: ■ Complete ☐ Incomplete Additional information to be collected in this and future investigations.

Known Contaminants	*Highest Observed Concentration (specify units and media)*	*PEL/TLV ppm or mg/m³ (specify)*	*IDLH ppm or mg/m³ (specify)*	*Excursion Limit (≤30 minutes)*	*Symptoms/Effects of Acute Exposure*	*Photoionization Potential*
Asbestos	10 percent (S)	0.1 f/cc (A)	N/A	NA	Assumed to be similar to overexposure of nuisance dust (e.g., eye irritant)	N/A

ACGIH = American Conference of Government Industrial Hygienists
CA = Human carcinogen
CAS = Chemical Abstract Service
IDLH = Immediately Dangerous to Life and Health (NIOSH standard enforced by law)
LEL = Lower Explosive Limit
mg/m^3 = milligrams per cubic meter
NE = Not established
NIOSH = National Institute for Occupational Safety and Health
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Limit (OSHA-established workplace standards enforced by law)
ppm = parts per million
STEL = Short Term Exposure Limit (15 minute TWA)
TLV = Threshold Limit Values (Recommended by ACGIH)
TWA = Time-Weighted Average (Average concentration for a normal 8-hour working day or 40-hour working week)
µg/kg = micrograms per kilogram
µg/ = micrograms per Liter

* = personal air monitoring
** = ambient/perimeter re-occupancy
*** = cutting hole in ceiling - 30 minute excursion

Field Activities Covered under this Plan				*Hazard*
Task Description/specific Technique-Standard Operating Procedures/Site Location(attach additional sheets as necessary)	*Type*	*Primary*	*Contingency*	*Schedule*
1 Attic Inspections	Intrusive	Level C - Modified	Exit Area	Hazard Risk: LOW
	Non-Intrusive			Date: 2003
2 Building Material Inspections	Intrusive	Level C - Modified	Exit Area	Hazard Risk: LOW
	Non-Intrusive			Date: 2003
3 Dust Sampling	Intrusive	Level D- Modified	Level C - Modified	Hazard Risk: LOW
	Non-Intrusive			Date: 2003
4 Soil Sampling for suspected contaminated areas	Intrusive	Level C- Modified	Exit Area	Hazard Risk: LOW
	Non-Intrusive			Date: 2003
5	Intrusive			Hazard Risk:
	Non-Intrusive			Date:
6	Intrusive			Hazard Risk:
	Non-Intrusive			Date:
7	Intrusive			Hazard Risk:
	Non-Intrusive			Date:

Personnel and Responsibilities (Include subcontractors)

Name	Firm/Region	CDM Federal Health Clearance	Responsibilities	Onsite Involvement
Jeff Montera	CDM - Denver	Yes	Project Manager	No
Dave Schroeder	CDM - Chantilly	Yes	Onsite Manager	Task 1 -4
Dee Warren	CDM - Denver	Yes	Task Leader	Task 1 -4

Protective Equipment: Specify by task. Indicate type and/or material as necessary. Use copies of this sheet if needed.

Block A — **Tasks: 1** — **Level: C - Modified** — ■ **Primary** ☐ **Contingency**

Respiratory: ☐ Not Needed
☐ SCBA, Airline:
■ APR: Full or half face
■ Cartridge: P100
☐ Escape Mask:
☐ Other:

Head and Eye: ☐ Not Needed
■ Safety Glasses: with half race respirator
☐ Face Shield:
☐ Goggles:
☐ Hard Hat:
☐ Other:

Boots: ☐ Not Needed
■ Boots: **Leather steel-toed safety boots/shoes**
■ Overboots:
☐ Rubber:

Prot. Clothing: ☐ Not Needed
☐ Encapsulated Suit:
☐ Splash Suit:
☐ Apron
■ Tyvek Coverall: if needed
☐ Cloth Coverall: Cotton as needed
☐ Other: Long pants & long-sleeved shirt

Gloves: ☐ Not Needed
☐ Undergloves:
■ Gloves: Nitrile or surgical/latex.
☐ Overgloves:

☐ Other - specify below

Block B — **Tasks: 1** — **Level: Exit Area** — ☐ **Primary** ■ **Contingency**

Respiratory: ☐ Not Needed
☐ SCBA, Airline:
☐ APR: Full or half face
☐ Cartridge: P100
☐ Escape Mask:
☐ Other:

Head and Eye: ☐ Not Needed
☐ Safety Glasses:
☐ Face Shield:
☐ Goggles:
☐ Hard Hat:
☐ Other:

Boots: ☐ Not Needed
☐ Boots: **Leather steel-toed safety boots/shoes**
☐ Overboots:
☐ Rubber:

Prot. Clothing: ☐ Not Needed
☐ Encapsulated Suit:
☐ Splash Suit:
☐ Apron
☐ Tyvek Coverall:
☐ Cloth Coverall: Cotton as needed
☐ Other: Long pants & long-sleeved shirt

Gloves: ☐ Not Needed
☐ Undergloves:
☐ Gloves: nitrile or surgical/latex
☐ Overgloves:

■ Other - specify below:
Exit area and consult H&S manager regarding PPE upgrade

Block C — **Tasks: 2** — **Level: C - Modified** — ■ **Primary** ☐ **Contingency**

Respiratory: ☐ Not Needed
☐ SCBA, Airline:
■ APR: Full or half face
■ Cartridge: P100
☐ Escape Mask:
☐ Other:

Head and Eye: ☐ Not Needed
■ Safety Glasses: with half face
☐ Face Shield:
☐ Goggles:
☐ Hard Hat:
☐ Other:

Boots: ☐ Not Needed
■ Boots: **Leather steel-toed safety boots/shoes**
■ Overboots:
☐ Rubber:

Prot. Clothing: ☐ Not Needed
☐ Encapsulated Suit:
☐ Splash Suit:
☐ Apron
■ Tyvek Coverall:
☐ Cloth Coverall:
☐ Other:

Gloves: ☐ Not Needed
☐ Undergloves:
■ Gloves: Nitrile or surgical/latex.
☐ Overgloves:

☐ Other - specify below:

Block D — **Tasks: 2** — **Level: Exit Area** — ☐ **Primary** ■ **Contingency**

Respiratory: ☐ Not Needed
☐ SCBA, Airline:
☐ APR:
☐ Cartridge:
☐ Escape Mask:
☐ Other:

Head and Eye: ☐ Not Needed
☐ Safety Glasses:
☐ Face Shield:
☐ Goggles:
☐ Hard Hat:
☐ Other:

Boots: ☐ Not Needed
☐ Boots: **Leather steel-toed safety boots/shoes**
☐ Overboots:
☐ Rubber:

Prot. Clothing: ☐ Not Needed
☐ Encapsulated Suit:
☐ Splash Suit:
☐ Apron
☐ Tyvek Coverall:
☐ Cloth Coverall:
☐ Other:

Gloves: ☐ Not Needed
☐ Undergloves:
☐ Gloves:
☐ Overgloves:

■ Other - specify below:
Exit area and consult H&S manager regarding PPE upgrade

Protective Equipment: Specify by task. Indicate type and/or material as necessary. Use copies of this sheet if needed.

Block A — **Tasks: 3** — **Level: D - Modified** — ■ **Primary** ☐ **Contingency**

Respiratory: ■ Not Needed
☐ SCBA, Airline:
☐APR:
☐Cartridge: P100
☐ Escape Mask:
☐ Other:

Head and Eye: ☐ Not Needed
■ Safety Glasses:
☐ Face Shield:
☐ Goggles:
☐ Hard Hat:
☐ Other:

Boots: ☐ Not Needed
■ Boots: **Leather steel-toed safety boots/shoes**
☐ Overboots:
☐ Rubber:

Prot. Clothing: ■ Not Needed
☐ Encapsulated Suit:
☐ Splash Suit:
☐ Apron
☐ Tyvek Coverall: if needed
☐ Cloth Coverall: Cotton as needed
☐ Other: Long pants & long-sleeved shirt

Gloves: ■ Not Needed
☐ Undergloves:
☐ Gloves: Nitrile or surgical/latex.
☐ Overgloves:

☐ Other - specify below:

Block B — **Tasks: 3** — **Level: C- Modified** — ☐ **Primary** ■ **Contingency**

Respiratory: ☐ Not Needed
☐ SCBA, Airline:
■ APR: Full or half face
■ Cartridge: P100
☐ Escape Mask:
☐ Other:

Head and Eye: ☐ Not Needed
■ Safety Glasses:
☐ Face Shield:
☐ Goggles:
☐ Hard Hat:
☐ Other:

Boots: ☐ Not Needed
■ Boots: **Leather steel-toed safety boots/shoes**
■ Overboots:
☐ Rubber:

Prot. Clothing: ☐ Not Needed
☐ Encapsulated Suit:
☐ Splash Suit:
☐ Apron
■ Tyvek Coverall:
☐ Cloth Coverall: Cotton as needed
☐ Other: Long pants & long-sleeved shirt

Gloves: ☐ Not Needed
☐ Undergloves:
■ Gloves: nitrile or surgical/latex
☐ Overgloves:

☐ Other - specify below:

Block C — **Tasks: 4** — **Level: C- Modified** — ■ **Primary** ☐ **Contingency**

Respiratory: ☐ Not Needed
☐ SCBA, Airline:
■ APR: Full or half face
■ Cartridge:P100
☐ Escape Mask:
☐ Other: PAPA

Head and Eye: ☐ Not Needed
■ Safety Glasses: with half face
☐ Face Shield:
☐ Goggles:
☐Hard Hat:
☐ Other:

Boots: ☐ Not Needed
■ Boots: **Leather steel-toed safety boots/shoes**
☐ Overboots:
☐ Rubber:

Prot. Clothing: ☐ Not Needed
☐ Encapsulated Suit:
☐ Splash Suit:
☐ Apron
■ Tyvek Coverall:
☐ Cloth Coverall:
☐ Other:

Gloves: ☐ Not Needed
☐ Undergloves:
■ Gloves: Nitrile or surgical/latex.
☐ Overgloves:

☐ Other - specify below:

Block D — **Tasks: 4** — **Level: Exit Area** — ☐ **Primary** ■ **Contingency**

Respiratory: ■ Not Needed
☐ SCBA, Airline:
☐ APR: Full or half face
☐ Cartridge:P100
☐ Escape Mask:
☐ Other:

Head and Eye: ■ Not Needed
☐ Safety Glasses:
☐ Face Shield:
☐ Goggles:
☐ Hard Hat:
☐ Other:

Boots: ☐ Not Needed
■ Boots: **Leather steel-toed safety boots/shoes**
☐ Overboots:
☐ Rubber:

Prot. Clothing: ■ Not Needed
☐ Encapsulated Suit:
☐ Splash Suit:
☐ Apron
☐ Tyvek Coverall:
☐ Cloth Coverall:
☐ Other:

Gloves: ■ Not Needed
☐ Undergloves:
☐ Gloves: Nitrile or surgical/latex.
☐ Overgloves:

☐ Other - specify below: **Exit area and consult H&S manager regarding PPE upgrade**

Monitoring Equipment: Specify by task. Indicate type as necessary. Attach additional sheets as necessary.

Instrument	*Task*	*Action Guidelines*	*Comments (Include schedules of use)*
Combustible Gas Indicator	1 - 4	0-10% LEL — No explosion hazard 10-25% LEL — Potential explosion hazard; notify SHSC. **>25% LEL — Explosion hazard; interrupt task/evacuate** 21.0% 0_2 <21.0% 0_2 — Oxygen normal **<19.5% 0_2 — Oxygen deficient; notify SHSC Interrupt task/evacuate**	■ Not Needed Entering tanks, vats, sumps, and other confined spaces is strictly forbidden.
Radiation Survey Meter Type _____	1 - 4	3X Background — Notify SHSO and CDM Federal HSM, establish REZ **>2mR/hr — Interrupt task/evacuate**	■ Not Needed Radiation is not an expected hazard.
Photoionization Detector Type _____ ☐ 11.7 eV ☐ 10.2 eV ☐ 9.8 eV ☐ ___ eV	1 - 4	**Specify:** **Detectable Odor — If odor of any kind is detected, cease work, move to fresh air.**	■ Not Needed If further work is necessary in the area where odors are detected, personnel protection will be evaluated.
Flame Ionization Detector Type _____	1 - 4	**Specify:**	■ Not Needed If further work is necessary in the area where odors are detected, personnel protection will be evaluated.
Detector Tubes/Monitor Type _____ Type _____	1 - 4	**Specify:**	■ Not Needed Toxic gases are not expected to be encountered. Entrance into confined spaces where toxic gases could be concentrated is strictly forbidden.
Respirable Dust Monitor Type _____ Type _____	1 - 4	**Specify:**	■ Not Needed If dusty conditions persist, site will be abandoned and personnel protection reevaluated.
Other **Specify: Visible or nuisance dust and/or unusual vapors (odors)**	1 - 4	**Specify: If team notices unusual odors, heavy dust, or irritation of the eyes or throat, they will exit area and reevaluate personnel protection.**	

Decontamination Procedures

Personalized Decontamination

Wash well before hand to mouth contact is made. A shower will be taken as soon as possible after leaving the field. Workers will remove protective clothing in this order:

(1) wash overboots in soapy water and rinse
(2) remove overboots or booties
(3) remove gloves
(4) wet wipe and remove safety glasses
(5) remove Tyvek or cloth coverall, if used
(6) remove respirator, if used
(7) remove inner gloves
(8) wash hands/face before eating/drinking

☐ Not Needed

Sampling Equipment Decontamination

See CDM Federal SOP 4-5. All sampling equipment will be thoroughly decontaminated as follows:

(1) wash and scrub with low phosphate detergent
(2) potable tap water rinse
(3) potable tap water rinse
(4) thoroughly rinse with deionized water
(5) air dry
(6) wrap in aluminum foil for transport

☐ Not Needed

Heavy Equipment Decontamination

See CDM Federal SOP 4-5. All heavy equipment and tool parts that contact subsurface soil are constructed of heavy gauge steel and have no natural or synthetic components that could absorb and retain most soil-borne organic contaminants.

Prior to removal from the work site, potential contaminated soil/groundwater will be scraped or brushed from the exterior surfaces.

The drill rig, augers and any other large equipment in the exclusion zone will be taken to a decon pad and steam cleaned.

■ Not Needed

Containment and Disposal Method

All disposable PPE will be double-bagged prior to disposal. Decon water to be disposed onsite.

☐ Not Needed

Containment and Disposal Method

Decon water to be disposed onsite.

☐ Not Needed

Containment and Disposal Method

All disposable PPE will be double-bagged prior to disposal.

■ Not Needed

Hazardous Materials Inventory (Investigation-Associated Substances: Attach MSDS)

Preservatives

☐ Hydrochloric Acid (HCl)
☐ Nitric Acid (HNO_3)
☐ Sulfuric Acid (H_2SO_4)
☐ Sodium Hydroxide (NaOH)
☐ Zinc Acetate (ZnOAc)
☐ Ascorbic Acid
☐ Other:
☐ Other:

Decontamination

■ Alconox™
☐ Liquinox™
☐ Acetone
☐ Methanol
☐ Mineral Spirits
☐ Hexane
☐ Isopropanol
☐ Nitric Acid
■ Other: Water

Calibration Gases and Fluids

☐ Isobutylene
☐ Methane
☐ Pentane
☐ Hydrogen
☐ Propane
☐ pH Standard
☐ Conductivity Standard
☐ Other
☐ Other

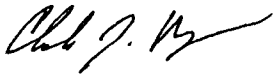
Health and Safety Plan Form	Environmental Protection Agency -- Region 8 --	CDM Federal Programs Corporation

Emergency Contacts	
Water Supply	NA
Site Telephone	1-406-293-8595
EPA Release Report No.	1-800-424-8802
CDM 24-Hour Emergency Chuck Myers	(cell) 1-571-216-7004
Facility Management	NA
Other (Specify) Health & Safety Mgr.	Chuck Myers (home) 1-703-754-0700 SHSO 1-406-293-3567
CHEMTREC Emergency	1-800-424-9300

Contingency Plans Summarize below:

Evacuate site if any unexpected hazardous conditions are encountered. If staff observe hazards for which they have not been prepared, they will withdraw from the area and call CDM Federal Health and Safety. CDM Federal personnel will leave the site and upgrade their level of protection if they experience nausea or dizziness. No volatile compounds are expected to be encountered at concentrations dangerous to human health. If any odors are noted, work will cease and personnel protection reevaluated. In the event of medical emergency, contact Hospital, Police, or Sheriff's Department. If respirable dust is noted, additional engineering controls will be implemented. If these controls do not eliminate the exposure, personnel protection will be re-evaluated.

Health and Safety Plan Approvals

Prepared by: Dee Warren	Date: 4/24/03
SHSO Signature:	Date:
HSM Signature: 	Date:
For: Chuck Myers, CIH	

Emergency Contacts	*Name*	*Phone*
Health and Safety Manager	Chuck Myers, CIH	1-703-968-0900 (office)
Project Manager	Jeff Montera	1-303-295-1237
Site Health & Safety Coor.	Douglas J. Updike	1-816-412-3149
Site Health & Safety Officer	Shawn Oliveira/Noel Anderson	1-406-293-3567
EPA Contact	Jim Christiansen	1-303-312-6748
Environmental Agency		1-800-234-5677
Health Department		1-406-293-3757
Sheriff's Department	Lincoln County	911
State Spill Line		911
Fire Department	.	911
Police Department - Libby		911
State Police	Highway Patrol	1-800-525-5555
Poison Control Center		1-800-525-5042
Occupational Physician	Health Resources	1-800-229-3671

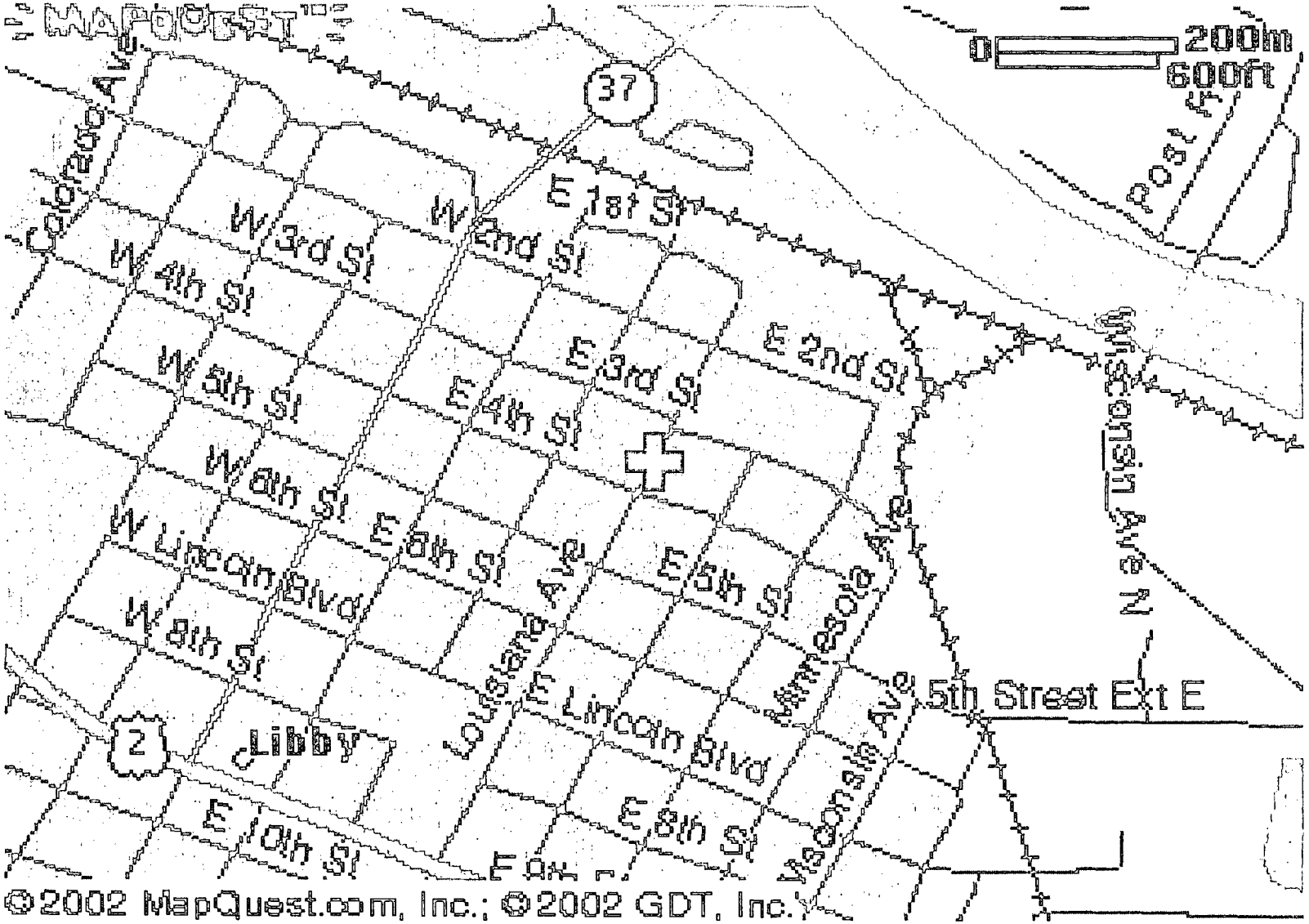
Medical Emergency

Hospital Name: St. John's Lutheran Hospital	406-293-7761
Hospital Address: 350 Louisiana Avenue	
Name of Contact at Hospital: NA	
Name of 24-Hour Ambulance:	911

Route to Hospital (See Figure 1)

Directions to the hospital will vary depending on where you are located in the site area. The hospital is located at the intersection of Louisiana and 4th Avenue.

This Page Reserved for Hospital Route Map: Johns Lutheran Hospital, 350 Louisiana Ave, Libby, MT 59923



Health and Safety Plan Form	Environmental Protection Agency -- Region 8 –	CDM Federal Programs Corporation

The following personnel have read and fully understand the contents of this Health and Safety Plan and further agree to all requirements contained herein.

Site: Libby, Montana, Asbestos Removal	Project No.:

Name and Responsibility	Affiliation	Date	Signature
Jeff Montera	CDM - Denver		
Dave Schroeder	CDM - Chantilly		

Appendix C

CDM Technical Standard Operating Procedures and Site-Specific Guidance Documents

Project-Specific Modification

SOP No.: 1-2

SOP Title: Sample Custody

Project: Libby Asbestos Remedial Investigation (RI)

Project No.: 3282-137

Client: U.S. Environmental Protection Agency

Project Manager: _____ Date: 5/7/03

Technical Reviewer: _____ Date: 5/7/03

QA Reviewer: _____ Date: 5/12/03

EPA Approval: _____ Date: 5/19/03

NOTE: Each media (soil/dust) must be submitted on separate COC forms.

The sample coordinator assistant will use the FSDS to complete an electronic chain of custody (eCOC). The sample coordinator will check the data entered to create the eCOC against the FSDSs. Three paper copies of the eCOC will then be generated. One copy will be filed in the CDM Libby office and the other two will be sent with the samples. The sample coordinator will then check the eCOC versus the sample containers and sample shipment. The sample coordinator will be responsible for shipment of samples. If any errors are found on an eCOC after shipment, the paper copy of the COC will be corrected by the sample coordinator with a single strikeout initial and date. The corrected copy will be faxed to Volpe and the laboratory. The fax to Volpe will be used to update the Libby project database.

Reason for and duration of modification: Sample custody procedures for the Libby asbestos project vary slightly from SOP 1-2. These modifications are necessary for the entire duration of the project.

Project-Specific Modification

Via: Hand delivery or shipped. Hand delivery refers to samples delivered by hand to the onsite laboratory; shipped refers to samples sent to the laboratory by delivery service (i.e., Federal Express). To be completed by the sample coordinator.

Project: All samples collected in accordance with this sampling and analysis plan (SAP) are part of the CSS. Circle CSS. To be completed by the field team.

Sample Placed in Cooler/Bag: Refers to visual confirmation of the sample in the shipping container. To be completed by the sample coordinator.

Index ID: Unique index identification number used to identify sample, in the form CSS-#####. To be completed by the field team.

Sample Date: The date each sample was collected, in the form MM/DD/YY. To be completed by the field team.

Sample Time: The time each sample was collected, in military time. To be completed by the field team.

Sample Matrix: The matrix of each sample collected, specific to the CSS; S = soil and W = water. To be completed by the field team.

Sample Type: Sample type of each sample collected; G = grab, C = composite. To be completed by the field team.

Volume: Specific to air and dust samples. Does not pertain to the CSS. "NA" should be placed in this field. To be completed by the field team.

Analysis Request: Analysis of each sample collected. All soil samples will be analyzed by IR. IR will be written in the analysis request portion of the COC form by the field team. The sample coordinator and/or laboratory coordinator may request SEM analysis based on Table 5-2 of the SAP. The sample coordinator and/or laboratory coordinator will designate IR for the appropriate samples.

Comments: Any pertinent information regarding the sample (i.e., vermiculite visible) will be entered by either the field team or the sample coordinator.

Sample Received by Lab: To be checked by the sample custodian at the laboratory upon receipt of the samples to confirm presence of each sample on the COC record.

Project-Specific Modification

Total Number of Samples: Total number of samples on the COC form. To be completed by the field team.

Additional Comments: Any additional comments that relate to samples on the COC form (i.e., turn around times). To be completed by the field team or sample coordinator.

Relinquished by: (1) Signed by field team member that relinquishes samples to sample coordinator and company of person relinquishing samples to sample coordinator (i.e., CDM). Date of relinquish shall be in the form MM/DD/YY and time shall be in military time. (2) Additional relinquished by lines to be completed following standard sample custody procedures.

Received by: (1) Signed by sample coordinator that receives samples from the sampling team and company of person accepting samples from the field teams (i.e., CDM). Date and time of acceptance should be the same as date and time of relinquish. (2) Additional received by lines to be completed following standard sample custody procedures.

Sample Condition upon Receipt: Will reflect the condition of samples at the relinquish time (i.e., accept ok or not acceptable with an explanation). To be completed by the person receiving samples.

Page ___ of ___: Sequential page number of the entire COC set sent to the laboratory. To be completed by the sample coordinator.

SAMPLE CUSTODY

SOP 1-2
Revision: 3
Date October 12, 2001
Page 1 of 9

Prepared: David O. Johnson

Technical Review: Jackie Mosher

QA Review: Doug Updike

Approved: _____ 10/12/01
Signature/Date

Issued: Rose Mary Gustin 10/12/01
Signature/Date

1.0 OBJECTIVE

Due to the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in CDM Federal Programs Corporation (CDM Federal) files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

Note: Sample custody documentation requirements vary with the specific EPA region or client. This SOP is intended to present basic sample custody requirements, along with common options. Specific sample custody requirements should be presented in the project-specific quality assurance (QA) project plan or project-specific modification or clarification form (See Section U-1).

2.0 BACKGROUND

2.1 Definitions

Sample – A sample is material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody – A sample is under custody if:

1. It is in your possession.
2. It is in your view, after being in your possession.
3. It was in your possession and you locked it up.
4. It is in a designated secure area.

Chain-of-Custody Record – A chain-of-custody record is a form used to document the transfer of custody of samples from one individual to another.

Custody Seal - A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

Sample Label – A sample label is an adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag – A sample tag is attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is difficult to physically place adhesive labels on the container (e.g., in the case of small air sampling tubes).

3.0 RESPONSIBILITIES

Sampler – The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader (FTL) – The FTL is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The FTL is also responsible for coordinating with the subcontractor laboratory to ensure that adequate information is recorded on custody records. The FTL determines whether proper custody procedures were followed during the fieldwork and decides if additional samples are required.

Field Sample Custodian – The field sample custodian, when designated by the FTL, is responsible for accepting custody of samples from the sampler(s) and properly packing and shipping the samples to the laboratory assigned to do the analyses. A field sample custodian is typically designated only for large and complex field efforts.

4.0 REQUIRED SUPPLIES

- Chain-of-custody records (applicable client or CDM Federal forms)
- Custody seals
- Sample labels or tags
- Clear tape

5.0 PROCEDURES

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a chain-of-custody record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations prior to the actual fieldwork. As few people as possible should handle samples.

2. Complete sample labels or tags for each sample, using waterproof ink.

Transfer of Custody and Shipment

1. Complete a chain-of-custody record for all samples (see Figure 1 for an example of a chain-of-custody record. Similar forms may be used when requested by the client). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory.

   - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the chain-of-custody record.

   - In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.

   - If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of-custody record.

NOTE: If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher (refer to Figure 1).

2. Package samples properly for shipment and dispatch to the appropriate laboratory for analysis. Each shipment must be accompanied with a separate chain-of-custody record.

3. Include a chain-of-custody record identifying its content in all shipments (refer to Figure 1). The original record will accompany the shipment, and the copies will be retained by the FTL and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the FTL as part of the permanent documentation.

Figure 1
EXAMPLE CDM Federal Chain-of-Custody Record

CDM Federal Programs Corporation
A subsidiary of Camp Dresser & McKee Inc.

125 Maiden Lane, 5th Floor
New York, NY 10038
(212) 785-9123
Fax: (212) 785-6114

CHAIN OF CUSTODY RECORD

PROJECT ID.	FIELD TEAM LEADER	LABORATORY AND ADDRESS	DATE SHIPPED
PROJECT NAME/LOCATION		LAB CONTRACT:	AIRBILL NO.

MEDIA TYPE
1. Surface Water
2. Groundwater
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil
7. Waste
8. Other _____

PRESERVATIVES
1. HCl, pH <2
2. HNO3, pH <2
3. NaOH, pH >12
4. H2SO4, pH <2
5. Zinc Acetate, pH >9
6. Ice Only
7. Not Preserved
8. Other _____

SAMPLE TYPE
G = Grab
C = Composite

SAMPLE LOCATION NO.	LABORATORY SAMPLE NUMBER	PRESER-VATIVES ADDED	MEDIA TYPE	SAMPLE TYPE	19__ DATE	TIME SAMPLED	ANALYSES (List no. of containers submitted)								REMARKS (Note if MS/MSD)
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															

SAMPLER SIGNATURES:

RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	

COMMENTS:

DISTRIBUTION: White and yellow copies accompany sample shipment to laboratory; yellow copy retained by laboratory. Pink copy retained by samplers. 1/98

NOTE: If requested by the client, different chain-of-custody records may be used. Copies of the template for this record may be obtained from the Fairfax Graphics Department.

Procedure for Completing CDM Federal Example Chain-of-Custody Record (Refer to Figure 1.)

The following procedure is to be used to fill out the CDM Federal chain-of-custody record. The record is provided herein as an example chain-of-custody record. If another type of custody record (i.e., provided by the EPA contract laboratory program or a subcontract laboratory) is used to track the custody of samples, the custody record should be filled out in its entirety.

1. Record project number.
2. Record FTL for the project (if a field sample custodian has been designated, also record this name in the "Remarks" box).
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record overnight courier's airbill number.
6. Record sample location number.
7. Record sample number.
8. Note preservatives type and reference number.
9. Note media type (matrix) and reference number.
10. Note sample type.
11. Enter date of sample collection.
12. Enter time of sample collection in military time.
13. When required by the client, enter the names or initials of the samplers next to the sample location number of the sample they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter MS/MSD (matrix spike/matrix spike duplicate) if sample is for laboratory quality control or other remarks (e.g. sample depth).
16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.
17. If sample tags are used, record the sample tag number in the "Remarks" column.
18. Record date shipped.
19. The originator checks information entered in Items 1 through 16 and then signs the top left "Relinquished by" box, prints his/her name, and enters the current date and time (military).

20. Send the top two copies (usually white and yellow) with the samples to the laboratory; retain the third copy (usually pink) for the project files. Retain additional copies for the project file or distribute as required to the appropriate sample coordinators.

21. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under "Remarks" on the chain-of-custody record. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the copy. The white copy is returned to CDM Federal.

5.2 Sample Labels and Tags

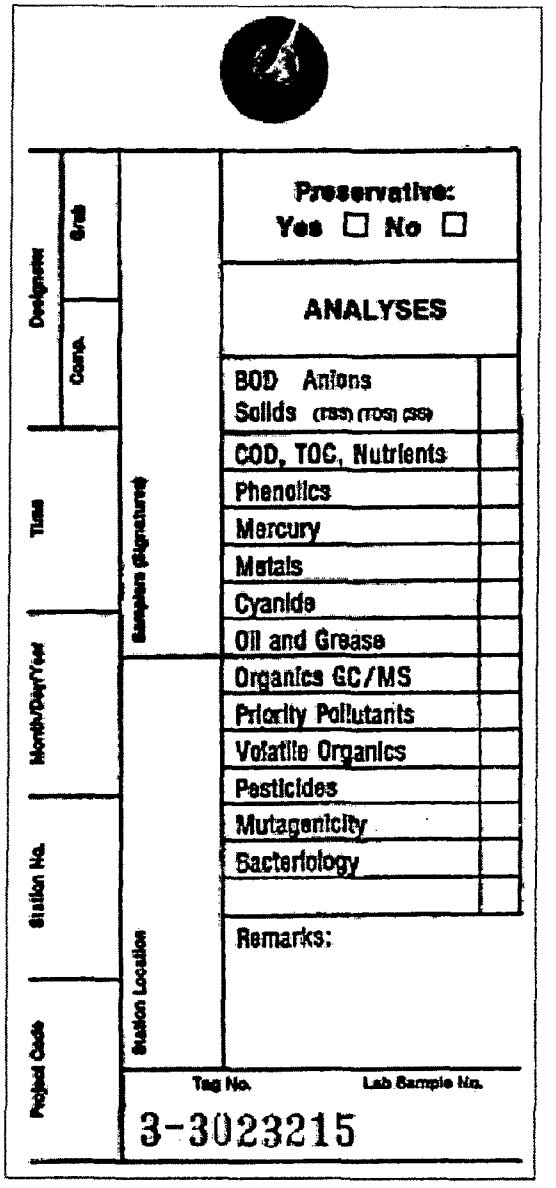
Unless the client directs otherwise, sample labels or tags will be used for all samples collected or accepted for CDM Federal projects.

1. Complete one label or tag with the information required by the client for each sample container collected. A typical label or tag would be completed as follows (see Figure 2 for example of sample tag; labels are completed with the equivalent information):
   - Record the project code (i.e., project or task number).
   - Enter the station number (sample number) if applicable.
   - Record the date to indicate the month, day, and year of sample collection.
   - Enter the time (military) of sample collection.
   - Place a check to indicate composite or grab sample.
   - Record the station (sample) location.
   - Sign in the space provided.
   - Place a check next to "yes" or "no" to indicate if a preservative was added.
   - Place a check under "Analyses" next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. Note: Do not write in the box for "laboratory sample number."
   - Place or write additional relevant information under "Remarks".

2. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.

3. Securely attach sample tags to the sample bottle. On 80 oz. amber bottles, the tag string may be looped through the ring style handle and tied. On all other containers, it is recommended that the string be looped around the neck of the bottle, then twisted and re-looped around the neck until the slack in the string is removed.

Figure 2
EXAMPLE Sample Tag



NOTE: Equivalent sample labels or tags may be used.

5.3 Custody Seals

Custody seals must be placed on the shipping containers (e.g., picnic cooler) prior to shipment. The seal should be signed and dated by a field team member.

Custody seals may also be placed on individual sample bottles. Check with the client or refer to EPA regional guidelines for direction.

5.4 Sample Shipping

The CDM Federal standard operating procedure listed below defines the requirements for packaging and shipping environmental samples.

- CDM Federal SOP 2-1, Packaging and Shipping of Environmental Samples

6.0 RESTRICTIONS/LIMITATIONS

Check with the EPA region or client for specific guidelines. If no specific guidelines are identified, this procedure should be followed.

For EPA Contract Laboratory Program (CLP) sampling events, combined chain-of-custody/traffic report forms or other EPA-specific records may be used. Refer to regional guidelines for completing these forms.

The EPA FORMS II Lite™ software may be used to customize sample labels and custody records when directed by the client or the CDM Federal project manager.

7.0 REFERENCES

U.S. Environmental Protection Agency, *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, EPA/600/R-98/018, February 1998, Section B3.

U.S. Environmental Protection Agency, *National Enforcement Investigations Center, Multi-Media Investigation Manual*, EPA-330/9-89-003-R, Revised March 1992, p.85.

U.S. Environmental Protection Agency, *Contract Laboratory Program (CLP), Guidance for Field Samplers*, EPA-540-R-00-003, Draft Final, June 2001, Section 3.2.

U.S. Environmental Protection Agency, *FORMS II Lite™ User's Guide*, March 2001

U.S. Environmental Protection Agency, Region IV, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, May 1996, Section 3.3.

U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plan*, EM 200-1-3, February 2001, Appendix F.

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Project-Specific Modification

SOP No.: 2-1

SOP Title: Packaging and Shipping of Environmental Samples

Project: Libby Asbestos Remedial Investigation (RI)

Project No.: 3282-137

Client: U.S. Environmental Protection Agency

Project Manager: _____ Date: 5/7/03

Technical Reviewer: _____ Date: 5/7/03

QA Reviewer: _____ Date: 5/12/03

EPA Approval: _____ Date: 5/19/03

Reason for and duration of modification: Procedures for shipping environmental samples for the Libby asbestos project vary slightly from CDM Technical SOP 2-1. These modifications are necessary for the entire duration of the project.

Samples collected during this investigation will be packaged and shipped in accordance with CDM Technical SOP 2-1, with the following modifications:

Section 1.4, Required Equipment - Vermiculite (or other absorbent material), bubble wrap, or ice will not be used for packaging or shipping samples.

Section 1.5, Procedures - No vermiculite or other absorbent material will be used to pack the samples. No ice will be used.

PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLES

SOP: 2-1
Revision: 1
Date: June 20, 2001

Prepared: Krista Lippoldt Technical Review: Brian Jenks

QA Review: David O. Johnson Approved: _____ Signature/Date

Issued: _____ Signature/Date

1.0 PACKAGING AND SHIPPING OF ALL SAMPLES – This standard operating procedure (SOP) applies to the packaging and shipping of all environmental samples. If the sample is preserved or radioactive, the following sections may also be applicable.

Section 2.0 – Packaging and Shipping of Samples Preserved with Hexane
Section 3.0 – Packaging and Shipping of Samples Preserved with Sodium Hydroxide
Section 4.0 – Packaging and Shipping of Samples Preserved with Hydrochloric Acid
Section 5.0 – Packaging and Shipping of Samples Preserved with Nitric Acid
Section 6.0 – Packaging and Shipping of Samples Preserved with Sulfuric Acid
Section 7.0 – Packaging and Shipping of Limited Quantity Radioactive Samples

1.1 OBJECTIVE

The objective of this SOP is to outline the requirements for the packaging and shipment of environmental samples.

1.2 BACKGROUND

1.2.1 Definitions

Environmental Sample - An environmental sample is any sample that has less than reportable quantities for any hazardous constituents according to Department of Transportation (DOT) regulations promulgated in 49 CFR - Part 172.

Custody Seal – A custody seal is a narrow adhesive-backed seal that is applied to individual sample containers and/or the sample shipping container (i.e. cooler) before offsite shipment. Custody seals are used as a protective mechanism to ensure that sample integrity is not compromised during transportation from the field to the analytical laboratory.

Secondary Containment – A secondary containment is the container that the sample is shipped in (i.e., plastic overpackaging if liquid sample is collected in glass).

Exempted Quantity – Exempted quantity is the amount of hazardous material that does not fall under DOT/IATA/ICAO regulations. This exemption is very difficult to meet; most shipments will be made under limited quantity.

Limited Quantity – Limited quantity is the maximum amount of a hazardous material for which there is a specific labeling or packaging exception.

Performance Testing – Performance testing is the required testing of outer packaging. These tests include the drop and stacking test.

Qualified Shipper – A qualified shipper is a person who has been adequately trained to perform the functions of shipping hazardous materials.

1.2.2 Discussion

Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis.

1.2.3 Associated Procedure

- CDM Federal SOP 1-2, Sample Custody

1.3 RESPONSIBILITIES

Field Team Leader (FTL) - The field team leader is responsible for ensuring that packaging and sampling procedures are conducted in accordance with this SOP. The field team leader is also responsible for ensuring that CDM Federal properly coordinates laboratory analysis of samples.

1.4 REQUIRED EQUIPMENT

- Coolers with return address of CDM Federal office
- Heavy-duty plastic garbage bags
- Plastic Ziploc®-type bags, small and large
- Clear tape
- Fiber tape – nylon reinforced strapping tape
- Duct tape
- Vermiculite (or equivalent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Completed chain-of-custody record or CLP custody records, if applicable
- Completed bill of lading
- "This End Up" and directional arrow labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

1.5 PROCEDURES

The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of "Environmental Sample" and are not a hazardous material as defined by DOT. Professional judgment and/or consultation with the appropriate health and safety coordinator or the health and safety manager should be observed.

2. Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape. Line the cooler with a large heavy-duty plastic garbage bag.

3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-2, Sample Custody).

4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Bottles may be wrapped in bubble wrap. Optionally, place three to six VOA vials in a quart metal can and then fill the can with vermiculite or equivalent. Note: Trip blanks must be included in coolers containing VOA samples.

5. Place 2 to 4 inches of vermiculite (or equivalent) into a cooler that has been lined with a garbage bag, and then place the bottles and cans in the bag with sufficient space to allow for the addition of more packing material between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather than horizontally.

6. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4° centigrade. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

7. Place the completed chain-of-custody record or the CLP traffic report form (if applicable) for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

8. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed chain-of-custody seal across the hinges of the cooler on opposite sides. The custody seals should be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

9. The shipping container lid must be marked "THIS END UP" and arrow labels that indicate the proper upward position of the container should be affixed to the cooler. A label containing the name and address of the shipper (CDM Federal) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

1.6 RESTRICTIONS/LIMITATIONS

The holding times for the samples packed for shipment must not be exceeded. It is recommended that samples be packed in time to be shipped nightly for overnight delivery. Use caution when shipping samples for weekend delivery; make arrangements with the laboratory before sending samples.

2.0 PACKAGING AND SHIPPING OF SAMPLES PRESERVED WITH HEXANE

2.1 OBJECTIVE

This section provides guidance for the shipment of soil and water environmental samples regulated under the DOT Hazardous Materials Regulations and the IATA/ICAO Dangerous Goods Regulations for shipment by air and applies only to domestic shipments.

2.2 BACKGROUND

2.2.1 Definitions

Section 1.2.1 defines the terms relevant to this section.

2.2.2 Transportation

This section was prepared for the shipment of hexane-preserved samples.

2.2.3 Containers

- 40 ml glass VOA vials (up to 1L per outer package)

2.3 RESPONSIBILITY

It is the responsibility of the qualified shipper to ensure that each shipment contains no more than the maximum of 24 VOA vials for a total liquid volume of 1 liter and that the shipment is packaged according to IATA/ICAO packaging instruction Y305 for limited quantities of hexane.

REQUIRED EQUIPMENT

- Outer packaging (for limited quantities) insulated cooler that has passed the performance test
- Garbage bags
- Clear tape
- Duct tape
- Strapping tape (optional)
- Ziploc®-type bags, small and large
- Vermiculite (or equivalent)*
- Bubble wrap
- Ice
- Chain-of-custody seals
- Chain-of-custody form
- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 3 flammable liquid labels
- Orientation labels
- Consignor/consignee labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

2.5 PACKAGING

The following steps are to be followed when packaging limited quantity samples shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials

- Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody)

- Wrap each container (40 ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble wrapped container into a 2.7 mil Ziploc®-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (Maximum of 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a Ziploc®-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

HEXANES MIXTURE
UN1208
LTD. QTY.

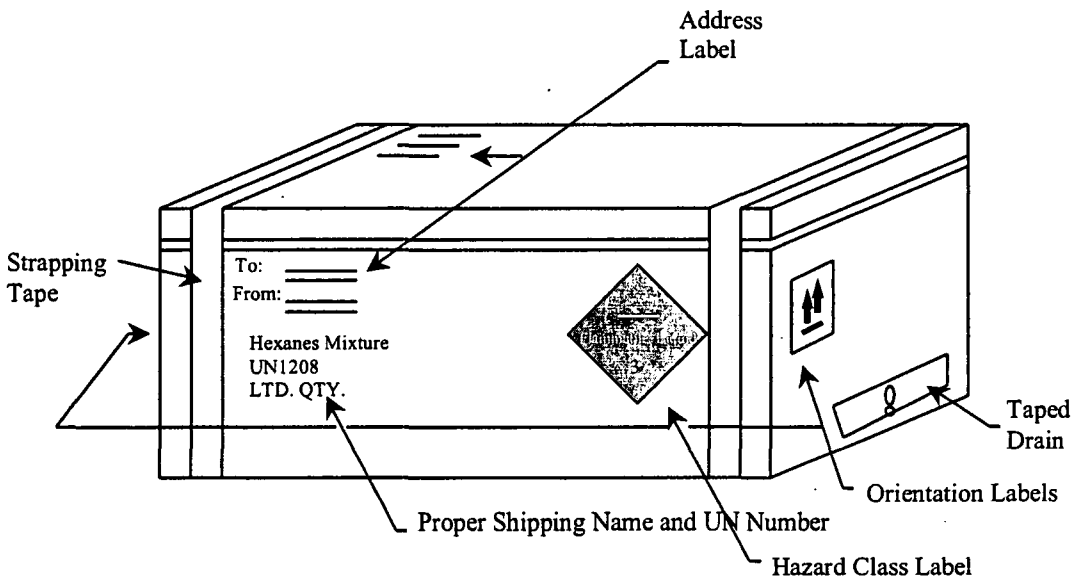
- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Flammable Liquid label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

NOTE: No marking or labeling can be obscured by strapping or duct tape.

NOTE: The inner packaging of dangerous goods may be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure the exterior surfaces do not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

Figure 1 Example of Cooler Label/Marking Locations



3.0 PACKAGING AND SHIPPING OF SAMPLES PRESERVED WITH SODIUM HYDROXIDE

3.1 OBJECTIVE

This section provides guidance for the shipment of soil and water environmental samples regulated under the DOT Hazardous Materials Regulations and the IATA/ICAO Dangerous Goods Regulations for shipment by air and applies only to domestic shipments.

3.2 BACKGROUND

3.2.1 Definitions

Section 1.2.1 defines the terms relevant to this section.

3.2.2 Transportation

This section was prepared for the shipment of sodium hydroxide (NaOH) preserved samples.

3.2.3 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Exempted Quantities of Preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
NaOH	30%	>12	0.08%		.25	0.5	1	2

5 drops = 1 ml

3.3 RESPONSIBILITY

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

REQUIRED EQUIPMENT

- Outer packaging (for limited quantities) insulated cooler that has passed the performance test.
- Garbage bags
- Clear tape
- Duct tape
- Strapping tape (optional)
- Ziploc®-type bags, small and large
- Vermiculite (or equivalent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Chain-of-custody form

- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

3.5 PACKAGING

Samples containing NaOH as a preservative that exceed the exempted concentration of 0.08 percent (2 ml of a 30 percent per liter) will be shipped as a limited quantity per packing instruction Y809 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited quantity samples shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody)
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble wrapped container into a 2.7 mil Ziploc®-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited quantity shipment of dangerous goods.

- Secure the chain-of-custody form (placed inside a Ziploc®-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

SODIUM HYDROXIDE SOLUTION
UN1824
LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

NOTE: Samples meeting the exemption concentration of 0.08 percent NaOH by weight will be shipped as non-regulated or non-hazardous.

NOTE: No marking or labeling can be obscured by strapping or duct tape.

NOTE: The inner packaging of dangerous goods may be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure the exterior surfaces do not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

4.0 PACKAGING AND SHIPPING OF SAMPLES PRESERVED WITH HYDROCHLORIC ACID

4.1 OBJECTIVE

This section provides guidance for the shipment of soil and water environmental samples regulated under the DOT Hazardous Materials Regulations and the IATA/ICAO Dangerous Goods Regulations for shipment by air and applies only to domestic shipments.

4.2 BACKGROUND

4.2.1 Definitions

Section 1.2.1 defines the terms relevant to this section.

4.2.2 Transportation

This section was prepared for the shipment of hydrochloric acid (HCl) preserved samples.

4.2.3 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Exempted quantities of preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
HCl	2N	<2	0.04%	.2	.5	1		

5 drops = 1 ml

4.3 RESPONSIBILITY

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

4.4 REQUIRED EQUIPMENT

- Outer packaging (for limited quantities) insulated cooler that has passed the performance test.
- Garbage bags
- Clear tape

- Duct tape
- Strapping tape (optional)
- Ziploc®-type bags, small and large
- Vermiculite (or equivalent)*
- Bubble wrap
- Ice
- Custody seals
- Chain-of-custody form
- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

4.5 PACKAGING

The following steps are to be followed when packaging limited quantity samples shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody)
- Wrap each container (40 ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble wrapped container into a 2.7 mil Ziploc®-type bag, removing trapped air.
- Place wrapped containers inside a polyethylene bottle filled with vermiculite; seal the bottle. (Maximum of 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.

- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a Ziploc®-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

HYDROCHLORIC ACID SOLUTION
UN1789
LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

NOTE: Samples meeting the exemption concentration of 0.04 percent HCl by weight will be shipped as non-regulated or non-hazardous.

NOTE: No marking or labeling can be obscured by strapping or duct tape.

NOTE: The inner packaging of dangerous goods may be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure the exterior surfaces do not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

5.0 PACKAGING AND SHIPPING OF SAMPLES PRESERVED WITH NITRIC ACID

5.1 OBJECTIVE

This section provides guidance for the shipment of soil and water environmental samples regulated under the DOT Hazardous Materials Regulations and the IATA/ICAO Dangerous Goods Regulations for shipment by air and applies only to domestic shipments.

5.2 BACKGROUND

5.2.1 Definitions

Section 1.2.1 defines the terms relevant to this section.

5.2.2 Transportation

This section was prepared for the shipment of nitric acid (HNO_3) preserved samples.

5.2.3 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Exempted quantities of preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
HNO_3	6N	<2	0.15%		2	4	5	8

5 drops = 1 ml

5.3 RESPONSIBILITY

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

5.4 REQUIRED EQUIPMENT

- Outer packaging (for limited quantities) insulated cooler that has passed the performance test.
- Garbage bags
- Clear tape
- Duct tape
- Strapping tape (optional)
- Ziploc®-type bags, small and large
- Vermiculite (or equivalent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Chain-of-custody form
- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

5.5 PACKAGING

Samples containing HNO_3 as a preservative that exceed the exempted concentration of 0.15% HNO_3 will be shipped as a limited quantity per packing instruction Y807 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited quantity samples shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody)

- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble wrapped container into a 2.7 mil Ziploc®-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a Ziploc®-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

NITRIC ACID SOLUTION (with less then 20%)
UN2031
LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

NOTE: Samples meeting the exemption concentration of 0.15 percent HNO_3 by weight will be shipped as non-regulated or non-hazardous.

NOTE: No marking or labeling can be obscured by strapping or duct tape.

NOTE: The inner packaging of dangerous goods may be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure the exterior surfaces do not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

6.0 PACKAGING AND SHIPPING OF SAMPLES PRESERVED WITH SULFURIC ACID

6.1 OBJECTIVE

This section provides guidance for the shipment of soil and water environmental samples regulated under the DOT Hazardous Materials Regulations and the IATA/ICAO Dangerous Goods Regulations for shipment by air and applies only to domestic shipments.

6.2 BACKGROUND

6.2.1 Definitions

Section 1.2.1 defines the terms relevant to this section.

6.2.2 Transportation

This section was prepared for the shipment of sulfuric acid (H_2SO_4) preserved samples.

6.2.3 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Exempted quantities of preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
		pH	Conc.	40 ml	125 ml	250 ml	500 ml	1 L
H_2SO_4	37N	<2	0.35%	.1	.25	0.5	1	2

5 drops = 1 ml

6.3 RESPONSIBILITY

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

6.4 REQUIRED EQUIPMENT

- Outer packaging (for limited quantities) insulated cooler that has passed the performance test.
- Garbage bags
- Clear tape
- Duct tape
- Strapping tape (optional)
- Ziploc®-type bags, small and large
- Vermiculite (or equivalent)*
- Bubble wrap
- Ice
- Custody seals
- Chain-of-custody form
- Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

6.5 PACKAGING

Samples containing H_2SO_4 as a preservative that exceed the exempted concentration of 0.35 percent will be shipped as a limited quantity per packing instruction Y809 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited quantity samples shipments.

- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection

  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody)
- Wrap each glass container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble wrapped container into a 2.7 mil Ziploc®-type bag, removing trapped air.
- Place glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a Ziploc®-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

SULFURIC ACID SOLUTION
UN2796
LTD. QTY.

- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix a Corrosive label to the outside of the cooler.
- Affix package orientation labels on two opposite sides of the cooler.
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of cooler labeling/marking locations is shown in Figure 1.

NOTE: Samples meeting the exemption concentration of 0.35 percent H_2SO_4 by weight will be shipped as non-regulated or non-hazardous.

NOTE: No marking or labeling can be obscured by strapping or duct tape.

NOTE: The inner packaging of dangerous goods may be placed into the designated cooler for shipment. Other non-regulated environmental samples may be added to the cooler for shipment.

- When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure the exterior surfaces do not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited Quantity (Appendix A).
- Complete a Dangerous Goods Airbill.

7.0 PACKAGING AND SHIPPING OF LIMITED QUANTITY RADIOACTIVE SAMPLES

7.1 OBJECTIVE

This section provides guidance for the shipment of soil and water environmental samples regulated under the DOT Hazardous Materials Regulations and the IATA/ICAO Dangerous Goods Regulations for shipment by air and applies only to domestic shipments.

7.2 BACKGROUND

7.2.1 Definitions

Section 1.2.1 defines the terms relevant to this section.

7.2.2 Transportation

This section was prepared for the shipment of environmental samples containing radioactive materials in limited quantities.

7.2.3 Containers

The inner packaging containers that may be used for these shipments include:

- Any size sample container

7.3 DESCRIPTION/RESPONSIBILITIES

- The qualified shipper will ship all samples that meet the Class 7 definition of radioactive materials and meet the activity requirements specified in Table 7 of 49 CFR 173.425, as Radioactive Materials in Limited Quantity. The qualified shipper will verify that all packages and their contents meet the requirements of 49 CFR 173.421, "Limited Quantities of Radioactive Materials."
- The packaging used for shipping will meet the general requirements for packaging and packages specified in 49 CFR 173.24 and the general design requirements provided in 173.410. These standards state that a package must be capable of withstanding the effects of any acceleration, vibration, or vibration resonance that may arise under normal condition of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use.
- If the shipment is from a Department of Energy (DOE) facility, radiological screenings will be completed on all samples taken. The qualified shipper will review the results of each screening (alpha, beta, and gamma speciation). Samples will not be shipped offsite until the radiological screening has been performed.
- The total activity for each package will not exceed the relevant limits listed in Table 7 of 49 CFR 173.425. The A_2 value of the material will be calculated based on all radionuclides found during previous investigations (if any) in the area from which the samples are derived. The A_2 values to be used will be the most restrictive of all potential radionuclides as listed in 49 CFR 173.435.
- The radiation level at any point on the external surface of the package bearing the sample(s) will not exceed 0.005 mSv/hour (0.5 mrem/hour). These will be verified by dose and activity monitoring prior to shipment of the package.
- The removable radioactive surface contamination on the external surface of the package will not exceed the limits specified in 49 CFR 173.443(a). CDM Federal will use the DOE-established free release criteria for removable surface contamination of less than 20 dpm/100 cm^2 (alpha) and 1000 dpm/100 cm^2 (beta/gamma). It should be noted that these values are more conservative than the DOT requirements for removable surface contamination.
- The qualified shipper will verify that the outside of the inner packaging is marked "Radioactive".
- The qualified shipper will verify that the excepted packages prepared for shipment under the provisions of 49 CFR 173.421 have a notice enclosed, or shown on the outside of the package, that reads, "This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910".

7.4 REQUIRED EQUIPMENT

- Cooler or other acceptable outer packaging
- Garbage bags
- Clear tape
- Duct tape
- Strapping tape (optional)
- Ziploc®-type bags, small and large
- Vermiculite (for water samples) or equivalent*
- Bubble wrap (optional)
- Ice (if necessary)
- Custody seals
- Chain-of-custody form
- Survey documentation/radiation screening results (if shipping from DOE or radiological sites)
- Orientation labels
- Exempted quantities label
- Consignor/consignee labels

* Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

7.5 PACKAGING

The following steps are to be followed when packaging limited quantity samples shipments.

- The cooler is to be surveyed by a qualified radiation control technician to ensure the exterior surfaces do not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
- All sample containers will be properly labeled and the label protected with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
- This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.

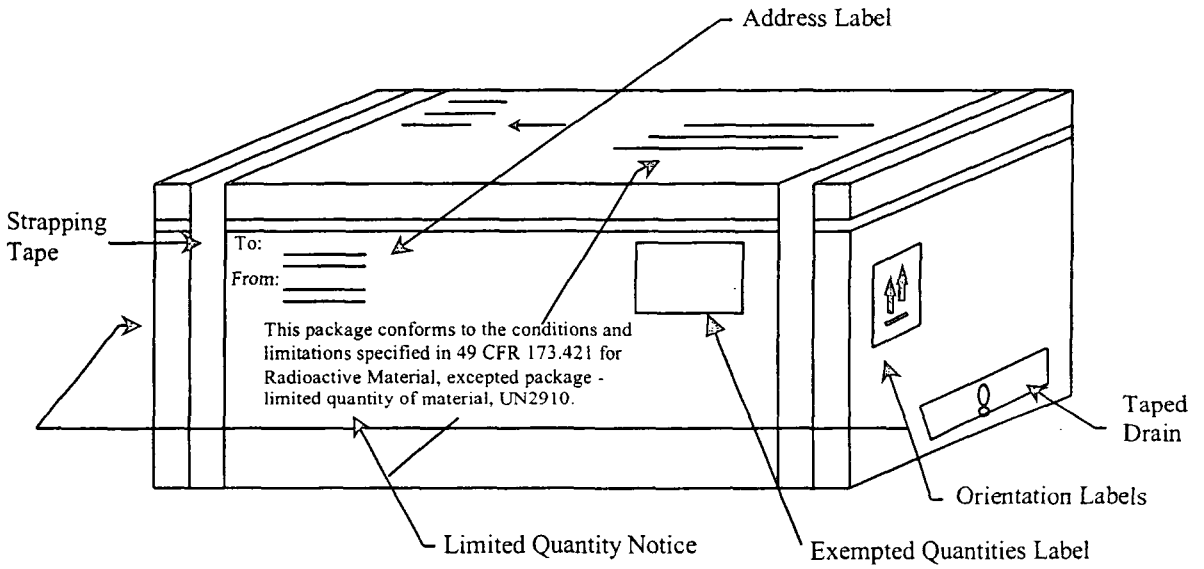
- Place sufficient amount of vermiculite, or approved packaging material, in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- If required, place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- Place a label marked "Radioactive" on the outside of the sealed bag.
- Enclose a notice that includes the name of the consignor or consignee and the following statement: "This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910.
- The maximum weight of the package shall not exceed 30 kg (66 lbs) for any limited quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a Ziploc®-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- If a cooler is used, wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler/package.
- Affix a completed Excepted Quantities label to the side of the cooler/package.
- Secure any marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.
- An example of the cooler labeling/marking is shown in Figure 2.

  NOTE: No marking or labeling can be obscured by strapping or duct tape.

- Complete the Shipment Quality Assurance Checklist (Appendix B).

  NOTE: Except as provided in 49 CFR 173.426, the package will not contain more than 15 grams of ^{235}U.
  NOTE: A declaration of dangerous goods is not required.

Figure 2 Radioactive Material - Limited Quantity Cooler Marking Example



8.0 REFERENCES

U.S. Environmental Protection Agency, *Sampler's Guide to the Contract Laboratory Program*, EPA/540/P-90/006, December 1990.

U.S. Environmental Protection Agency, Region IV, *Standard Operating Procedures and Quality Assurance Manual*, February 1991.

APPENDIX A
Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited Quantity

Sample Packaging

Yes	No	N/A	
❑	❑	❑	The VOA vials are wrapped in bubble wrap and placed inside a Ziploc®-type bag.
❑	❑	❑	The VOA vials are placed into a polyethylene bottle, filled with vermiculite, and tightly sealed.
❑	❑	❑	The drain plug is taped inside and outside to ensure control of interior contents.
❑	❑	❑	The samples have been placed inside garbage bags with sufficient bags of ice to preserve samples at 4°C.
❑	❑	❑	The cooler exceeds the 66-pound limit for limited quantity shipment.
❑	❑	❑	The garbage bag has been sealed with tape (or tied) to prevent movement during shipment.
❑	❑	❑	The chain-of-custody has been secured to the interior of the cooler lid.
❑	❑	❑	The cooler lid and sides have been taped to ensure a seal.
❑	❑	❑	The custody seals have been placed on both the front and back hinges of the cooler, using waterproof tape.

Air Waybill Completion

Yes	No	N/A	
❑	❑	❑	Section 1 has the shipper's name, company and address; the account number, date, internal billing reference number; and the telephone number where the shipper can be reached.
❑	❑	❑	Section 2 has the recipient's name and company along with a telephone number where they can be reached.
❑	❑	❑	Section 3 has the **Bill Sender** box checked.
❑	❑	❑	Section 4 has the **Standard Overnight** box checked.
❑	❑	❑	Section 5 has the **Deliver Weekday** box checked.
❑	❑	❑	Section 6 has the number of packages and their weights filled out. Was the total of all packages and their weights figured up and added at the bottom of Section 6?
❑	❑	❑	Under the **Transport Details** box, the **Cargo Aircraft Only** box is obliterated, leaving only the **Passenger and Cargo Aircraft** box.
❑	❑	❑	Under the **Shipment Type**, the **Radioactive** box is obliterated, leaving only the **Non-Radioactive** box.
❑	❑	❑	Under the **Nature and Quantity of Dangerous Goods** box, the **Proper Shipping Name, Class or Division, UN or ID No., Packing Group, Subsidiary Risk, Quantity and Type of Packing, Packing Instructions and Authorization** have been filled out for the type of chemical being sent.
❑	❑	❑	The **Name, Place & Date, Signature, and Emergency Telephone number** appears at the bottom of the FedEx Airbill.
❑	❑	❑	The statement "In accordance with IATA/ICAO" appears in the **Additional Handling Information** box.

Proper Shipping Name	Class or Division	UN or ID No.	Packing Group	Sub Risk	Quantity	Packing Instruction	Authorization
Hydrochloric Acid Solution	8	UN1789	II		1 plastic box × 0.5 L	Y809	LTD QTY
Nitric Acid Solution (with less than 20%)	8	UN2031	II		1 plastic box × 0.5 L	Y807	LTD QTY
Sodium Hydroxide Solution	8	UN1824	II		1 plastic box × 0.5 L	Y809	LTD QTY
Sulfuric Acid Solution	8	UN2796	II		1 plastic box × 0.5 L	Y809	LTD QTY
Hexanes	3	UN1208	II		1 plastic box × 1 L	Y305	LTD QTY

Sample Cooler Labeling

Yes	No	N/A	
❑	❑	❑	The proper shipping name, UN number, and LTD. QTY. appears on the shipping container.
❑	❑	❑	The corresponding hazard labels are affixed on the shipping container; the labels are not obscured by tape.
❑	❑	❑	The name and address of the shipper and receiver appear on the top and side of the shipping container.
❑	❑	❑	The air waybill is attached to the top of the shipping container.
❑	❑	❑	**Up Arrows** have been attached to opposite sides of the shipping container.
❑	❑	❑	Packaging tape does not obscure markings or labeling.

APPENDIX B
SHIPMENT QUALITY ASSURANCE CHECKLIST

Date: _____ Shipper: _____ Destination: _____

Item(s) Description: _____

Radionuclide(s): _____

Radiological Survey Results: surface _____mrem/hr 1 meter _____

Instrument Used: Mfgr: _____ Model: _____

S/N: _____ Cal Date: _____

LIMITED QUANTITY OR INSTRUMENT AND ARTICLE

Yes	No		
___	___	1.	Strong tight package (package that will not leak material during conditions normally incidental to transportation).
___	___	2.	Radiation levels at any point on the external surface of package less than or equal to 0.5 mrem/hr.
___	___	3.	Removable surface contamination less than 20 dpm/100 cm^2 (alpha) and 1000 dpm/100 cm^2 (beta/gamma).
___	___	4.	Outside inner package bears the marking "Radioactive".
___	___	5.	Package contains less than 15 grams of ^{235}U (check yes if ^{235}U not present).
___	___	6.	Notice enclosed in or on the package that includes the consignor or consignee and the statement, "This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."
___	___	7.	Activity less than that specified in 49 CFR 173.425. Permissible package limit: Package Quantity:
___	___	8.	On all air shipments, the statement, Radioactive Material, excepted package-limited quantity of material shall be noted on the air waybill.

Qualified Shipper: _____ Signature: _____

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Project Specific Modification

SOP No.: 2-2

SOP Title: Guide to Handling Investigation-Derived Waste

Project: Libby Asbestos Remedial Investigation (RI)

Project No.: 3282-137

Client: U.S. Environmental Protection Agency

Project Manager: _____ Date: 5/7/03

Technical Reviewer: _____ Date: 5/7/03

QA Reviewer: _____ Date: 5/12/03

EPA Approval: _____ Date: 5/19/03

Reason for and duration of modification: Site-specific procedures for disposing of Libby amphibole asbestos contaminated IDW are different than CDM Technical SOP 2-2. These modifications are necessary for the entire duration of the project.

All IDW will be handled in accordance with CDM Technical SOP 2-2, Guide to Handling Investigation-Derived Waste, with the following modifications:

Section 5.2, Off Site Disposal - All IDW (not including excess soil volume) will be collected in transparent garbage bags and marked "IDW" with an indelible marker. These bags will be deposited into the asbestos contaminated waste stream for deposal at the mine.

GUIDE TO HANDLING INVESTIGATION-DERIVED WASTE

SOP: 2-2
Revision: 3
Date: June 20, 2001

Prepared: Tim Eggert Technical Review: Mike Profit

QA Review: Krista Lippoldt Approved: _____ Signature/Date

Issued: _____ Signature/Date

1.0 OBJECTIVE

This standard operating procedure (SOP) presents guidance for the management of investigation-derived waste (IDW). The primary objectives for managing IDW during field activities include:

- Leaving the site in no worse condition than existed prior to field activities
- Remove wastes which pose an immediate threat to human health or the environment
- Proper handling of onsite wastes that do not require off site disposal or extended above-ground containerization
- Complying with federal, state, and facility applicable or relevant and appropriate requirements (ARARs)
- Careful planning and coordination of IDW management options
- Minimizing the quantity of IDW

2.0 BACKGROUND

2.1 Definitions

Hazardous Waste – Discarded material that is regulated listed waste, or waste that exhibits ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.3 or state regulations.

Investigation-Derived Wastes (IDWs) - Discarded materials resulting from field activities such as sampling, surveying, drilling, excavations, and decontamination processes that, in present form, possess no inherent value or additional usefulness without treatment. Wastes may be solid, liquid, or gaseous, or multiphase materials that may be classified as hazardous or non-hazardous.

Mixed-Waste - Any material that has been classified as hazardous and radioactive.

Radioactive Wastes – Discarded materials that are contaminated with radioactive constituents with specific activities in concentrations greater than the latest regulatory criteria (i.e., 10 CFR 20).

Treatment, Storage, and Disposal Facility (TSDF) - Permitted facilities which accept hazardous waste shipments for further treatment, storage, and/or disposal. These facilities must be permitted by the U.S. Environmental Protection Agency (EPA) and appropriate state agencies.

2.2 Discussion

Field investigation activities result in the generation of waste materials that may be characterized as a hazardous or radioactive waste. IDWs may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues from testing of treatment technologies and pump and treat systems; personal protective equipment (PPE); solutions (aqueous or otherwise) used to decontaminate non-disposable protective clothing and equipment; and other wastes or supplies used in sampling and testing potentially hazardous or radiologically contaminated material.

NOTE: The client's representatives may not be aware of all potential contaminants. The management of IDW must comply with regulatory requirements that are applicable.

3.0 RESPONSIBILITIES

Site Manager - The site manager is responsible for ensuring that all IDW procedures are conducted in accordance with this SOP. The site manager is also responsible for ensuring that handling of IDW is in accordance with site-specific requirements.

Project Manager - The project manager is responsible for identifying site-specific requirements for the disposal of IDW in accordance with federal, state, and/or facility requirements.

Field Crew Members - Field crew members are responsible for implementing this SOP and communicating any unusual or unplanned condition to the project manager's attention.

4.0 REQUIRED EQUIPMENT

Equipment required for IDW containment will vary according to site-specific/client requirements. Management decisions concerning the necessary equipment required should consider: containment method, sampling, labeling, maneuvering, and storage (if applicable). Equipment must be on site and inspected before commencing work.

4.1 IDW Containment Devices

The appropriate containment device (drums, tanks, etc.) will depend on site- or client-specific requirements and the ultimate disposition of the IDW. Typical IDW containment devices can include:

- Plastic sheeting (polyethylene) with a minimum thickness of 20 millimeters
- Department of Transportation (DOT) approved steel containers
- Bulk storage tanks comprised of polyethylene or steel

Containment of IDW should be segregated by waste type (i.e., solid or liquid, corrosive or flammable, etc.) and source location. Volume of the appropriate containment device should be site-specific.

4.2 IDW Container Labeling

A "Waste Container" or "IDW Container" label or indelible marking should be applied to each container. Labeling or marking requirements for onsite IDW not expected to be transported off site are:

- Labels and markings that contain the following information: project name; generation date; location of waste origin; container identification number; sample number (if applicable); contents (drill cuttings, purge water, PPE, etc.).
- Each label or marking will be applied to the upper one-third of the container at least twice, on opposite sides.
- Containers that are five-gallons or less may only require one label or set of markings.
- Labels or markings will be positioned on a smooth part of the container. The label must not be affixed across container bungs, seams, ridges, or dents.
- Labels must be constructed of a weather-resistive material with markings made with a permanent marker or paint pen and capable of enduring the expected weather conditions. If markings are used, the color must be easily distinguishable from the drum color.
- Labels will be secured in a manner to ensure the label remains affixed to the container.

Labeling or marking requirements for IDW expected to be transported off site must be in accordance with the requirements of 49 CFR 172.

4.3 IDW Container Movement

Staging areas for IDW containers should be predetermined and in accordance with site-specific and/or client requirements. Arrangements should be made prior to field mobilization as to the methods and personnel required to safely transport IDW containers to the staging area. Transportation off site onto a public roadway is prohibited unless 49 CFR 172 requirements are met.

4.4 IDW Container Storage

Containerized IDW should be staged pending chemical analysis or further onsite treatment. Staging areas and bulk storage procedures are to be determined according to site-specific requirements. Containers are to be stored in such a fashion that the labels can be easily read. A secondary/spill container must be provided as appropriate.

5.0 PROCEDURES

The three general options for managing IDW are (1) collection and onsite disposal; (2) collection for off site disposal; and (3) collection and interim management. Attachment 1 summarizes media-

specific information on generation processes and management options. The option selected should take into account the following factors:

- Type (soil, sludge, liquid, debris), quantity, and source of IDW
- Risk posed by managing the IDW on site
- Compliance with regulatory requirements
- IDW minimization and consistency with the IDW remedy and the site remedy

In all cases the client should approve the plans for IDW. Formal plans for the management of IDW must be prepared as part of a work plan or separate document.

5.1 Onsite Disposal

5.1.1 Soil/Sludge/Sediment

The options for handling soil/sludge/sediment IDW are as follows:

1. Return to boring, pit, or source immediately after generation as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

2. Spread around boring, pit, or source within the area of contamination (AOC) as long as returning the media to these areas will not increase site risks (e.g., direct contact with surficial contamination).

3. Consolidate in a pit within the AOC as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).

4. Send to onsite TSDF - may require analytical analysis prior to treatment/disposal.

NOTE: These options may require client and/or regulatory approval.

5.1.2 Aqueous Liquids

The options for handling aqueous liquid IDW are as follows:

1. Discharge to surface water, only when IDW is not contaminated.

2. Discharge to ground surface close to the well, only if soil contaminants will not be mobilized in the process and the action will not contaminate clean areas. If IDW from the sampling of background up-gradient wells is not a community concern nor associated with soil contamination, this presumably uncontaminated IDW may be released on the ground around the well.

3. Discharge to sanitary sewer.

4. Send to onsite TSDF - may require analysis prior to treatment/disposal.

NOTE: These options may require analytical results to obtain client and/or regulatory approval.

5.1.3 Disposable PPE

The options for handling disposable PPE are as follows:

1. Double-bag contents in non-transparent trash bags and place in onsite industrial dumpster, only if PPE is not contaminated.

2. Containerize, label, and send to onsite TSDF - may require analysis prior to treatment/ disposal.

5.2 Off Site Disposal

Before sending to an offsite TSDF, analysis may be required. Also, manifests are required. Arrangements must be made with the client responsible for the site; it is CDM Federal's policy not to sign manifests. The TSDF and transporter must be permitted for the respective wastes.

5.2.1 Soil/Sludge/Sediment

When the final site remedy requires off site treatment and disposal, the IDW may be stored (e.g., drummed, covered in a waste pile) or returned to its source until final disposal. The management option selected should take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.2 Aqueous Liquids

When the final site remedy requires off site treatment and disposal, the IDW may be stored (e.g., mobile tanks or drums) until final disposal. The management option selected should take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.3 Disposable PPE

When the final site remedy requires off site treatment disposal, the IDW may be containerized and stored. The management option selected should take into account potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.3 Interim Measures

All interim measures must be approved by the client and regulatory agencies.

1. Storing IDW on site until the final action may be practical in the following situations:

   A. Returning wastes (especially sludges and soils) to their onsite source area would require re-excavation for disposal in the final remediation alternative.

   B. Interim storage in containers may be necessary to provide adequate protection to human health and the environment.

   C. Off site disposal options may trigger land disposal regulations under the Resource Conservation and Recovery Act (RCRA). Storing IDW until the final disposal of all wastes from the site will eliminate the need to address this issue more than once.

   D. Interim storage may be necessary to provide time for sampling and analysis.

2. Segregate and containerize all waste for future treatment and/or disposal.

   A. Containment options for soil/sludge/sediment may include drums or covered waste piles in AOC.

   B. Containment options for aqueous liquids may include mobile tanks or drums.

   C. Containment options for PPE may include drums or roll-off boxes.

6.0 RESTRICTIONS/LIMITATIONS

SITE MANAGERS SHOULD DETERMINE THE MOST APPROPRIATE DISPOSAL OPTION FOR AQUEOUS LIQUIDS ON A SITE-SPECIFIC BASIS. Parameters to consider, especially when determining the level of protection, include the volume of IDW, the contaminants present in the groundwater, the presence of contaminants in the soil at the site, whether the groundwater or surface water is a drinking water supply, and whether the groundwater plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components.

Disposable sampling materials, disposable PPE, decontamination fluids, etc. will always be managed on a site-specific basis. **UNDER NO CIRCUMSTANCES SHOULD THESE TYPES OF MATERIALS BE BROUGHT BACK TO THE OFFICE OR WAREHOUSE.**

7.0 REFERENCES

Environmental Resource Center, *Hazardous Waste Management Compliance Handbook*, Van Nostrand Reinhold, 1992.

Institute of Hazardous Materials Management, *Handbook on Hazardous Materials Management*, 4th Ed., 1992.

U. S. Environmental Protection Agency, Region IV, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, May 1996 and 1997 revisions.

U. S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.1, 1987.

U. S. Environmental Protection Agency, *Management of Investigation-Derived Wastes During Site Inspections*, EPA/540/G-91/009, May 1991.

U. S. Environmental Protection Agency, *Low-Level Mixed Waste: A RCRA Perspective for NRC Licensees*, EPA/530-SW-90-057, August 1990.

U. S. Environmental Protection Agency, *Guide to Management of Investigation-Derived Wastes*, 9345.3-03FS, January 1992.

ATTACHMENT 1
IDW MANAGEMENT OPTIONS

TYPE OF IDW	GENERATION PROCESSES	MANAGEMENT OPTIONS
Soil	• Well/Test pit installations • Borehole drilling • Soil sampling	**Onsite Disposal** • Return to boring, pit, or source immediately after generation • Spread around boring, pit, or source within the AOC • Consolidate in a pit (within the AOC) • Send to onsite TSDF **Off site Disposal** • Client to send to off site TSDF **Interim Management** • Store for future treatment and/or disposal
Sludge/Sediment	• Sludge pit/sediment sampling	**Onsite Disposal** • Return to boring, pit, or source immediately after generation • Send to onsite TSDF **Off site Disposal** • Client to send to off site TSDF **Interim Management** • Store for future treatment and/or disposal
Aqueous liquids (groundwater, surface water, drilling fluids, wastewaters)	• Well installation/development • Well purging during sampling • Groundwater discharge during pump tests • Surface water sampling • Waste water sampling	**Onsite Disposal** • Pour onto ground close to well (non-hazardous waste) • Discharge to sewer • Send to onsite TSDF **Off site Disposal** • Client to send to off site commercial treatment unit • Client to send to publicly owned treatment works (POTW) **Interim Management** • Store for future treatment and/or disposal
Decontamination fluids	• Decontamination of PPE and equipment	**Onsite Disposal** • Send to onsite TSDF • Evaporate (for small amounts of low contamination organic fluids) • Discharge to ground surface **Off site Disposal** • Client to send to off site TSDF • Discharge to sewer **Interim Management** • Store for future treatment and/or disposal

ATTACHMENT 1
IDW MANAGEMENT OPTIONS

TYPE OF IDW	GENERATION PROCESSES	MANAGEMENT OPTIONS
Disposable PPE and Sampling Equipment	• Sampling procedures or other onsite activities	**Onsite Disposal** • Place in onsite industrial dumpster • Send to onsite TSDF **Off site Disposal** • Client to send to off site TSDF **Interim Management** • Store for future treatment and/or disposal

Adapted from U.S. Environmental Protection Agency, Guide to Management of Investigation-Derived Wastes, 9345-03FS, January 1992.

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Project-Specific Modification

SOP No.: 4-1

SOP Title: Field Logbook Content and Control

Project: Libby Asbestos Remedial Investigation (RI)

Project No.: 3282-137

Client: U.S. Environmental Protection Agency

Project Manager: _____ Date: 5/7/03

Technical Reviewer: _____ Date: 5/7/03

QA Reviewer: _____ Date: 5/12/03

EPA Approval: _____ Date: 5/19/03

Reason for and duration of modification: Site-specific procedures field logbook completions are different than CDM Technical SOP 4-1. These modifications are necessary for the entire duration of the project.

All content and control of will logbooks will be done accordance with CDM Technical SOP 4-1, Field Logbook Content and Control, with the following modifications:

Section 5.2, Operation – A new page will be completed for each property where information is collected for RI activities. The header information will include the address, the name of the property owner, and the building identification number of structures on the property.

When following the line-out and signature procedures to close a logbook page, the author must also print their name under the signature.

FIELD LOGBOOK CONTENT AND CONTROL

Prepared: Del Baird

Technical Review: Larry Davidson

QA Review: David O. Johnson

Approved: _____ 6/20/01
Signature/Date

Issued: _____ 6/20/01
Signature/Date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to set CDM Federal criteria for content entry and form of field logbooks. Field logbooks are an essential tool to document field activities for historical and legal purposes.

2.0 BACKGROUND

2.1 Definitions

Biota - The flora and fauna of a region.

Magnetic Declination Corrections - Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion

Information recorded in field logbooks includes field team names, observations, data, calculations, date/time, weather, and description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain deviations from plans and descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

3.0 RESPONSIBILITIES

Field Team Leader (FTL) - The FTL is responsible for ensuring that the format and content of data entries are in accordance with this procedure.

Site Personnel - All CDM Federal employees who make entries in field logbooks during onsite activities are required to read this procedure prior to engaging in this activity. The FTL will assign field logbooks to site personnel who will be responsible for their care and maintenance. Site personnel will return field logbooks to the records file at the end of the assignment.

4.0 REQUIRED EQUIPMENT

- Site-specific plans
- Field notebook
- Indelible black or blue ink pen
- Ruler or similar scale

5.0 PROCEDURES

5.1 Preparation

In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with all procedures applicable to the field activity being performed. These procedures should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation. These procedures should be located at the field office.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the logbook. Prior to use in the field, each logbook will be marked with a specific document control number issued by the document control administrator, if required by the contract quality implementation plan (QIP). Not all contracts require document control numbers. The following information shall be recorded on the cover of the logbook:

- Field logbook document control number.
- Activity (if the logbook is to be activity-specific) and location.
- Name of CDM Federal contact and phone number(s).
- Start date.
- In specific cases, special logbooks may be required (e.g., waterproof paper for storm water monitoring).

The first few (approximately five) pages of the logbook will be reserved for a table of contents (TOC). Mark the first page with the heading and enter the following:

TABLE OF CONTENTS

Date/Description	Page
(Start Date)/Reserved for TOC	1-5

The remaining pages of the table of contents will be designated as such with "TOC" written on the top center of each page.

5.2 Operation

The following is a list of requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information need not be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.

Specific requirements for field logbook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial and date all changes.
- Multiple authors must sign out the logbook by inserting the following:

  Above notes authored by:
  - (Sign name)
  - (Print name)
  - (Date)

- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:

  - Date and time
  - Name of individual making entry
  - Names of field team and other persons on site
  - Description of activity being conducted including station or location (i.e., well, boring, sampling location number) if appropriate
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
  - Level of personal protection to be used
  - Serial numbers of instruments
  - Required calibration information
  - Serial/tracking numbers on documentation (e.g., carrier air bills)

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is toward the top of the page. Maps, sketches, figures, or data that will not fit on a logbook page should be referenced and attached to the logbook to prevent separation.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personal protection equipment.

5.3 Post-Operation

To guard against loss of data due to damage or disappearance of logbooks, completed pages shall be periodically photocopied (weekly, at a minimum) and forwarded to the field or project office. Other field records shall be photocopied and submitted regularly and as promptly as possible to the office. When possible, electronic media such as disks and tapes should be copied and forwarded to the project office.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated, and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

6.0 RESTRICTIONS/LIMITATIONS

Field logbooks constitute the official record of onsite technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by CDM Federal personnel and their subcontractors. They are documents that may be used in court to indicate dates, personnel, procedures, and techniques employed during site activities. Entries made in these notebooks should be factual, clear, precise, and non-subjective. Field logbooks, and entries within, are not to be utilized for personal use.

7.0 REFERENCES

Sandia National Laboratories, *Procedure for Preparing, Sampling and Analysis Plan, Site-Specific Sampling Plan, and Field Operating Procedures*, QA-02-03, Albuquerque Environmental Program Department 3220, Albuquerque, New Mexico, 1991.

Sandia National Laboratories, Division 7723, *Field Operation Procedure for Field Logbook Content and Control, Environmental Restoration Department*, Albuquerque, New Mexico, 1992.

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Project-Specific Modification

SOP No.: 4-2

SOP Title: Photographic Documentation of Field Activities

Project: Libby Asbestos Remedial Investigation (RI)

Project No.: 3282-137

Client: U.S. Environmental Protection Agency

Project Manager: _____ Date: 5/7/03

Technical Reviewer: _____ Date: 5/7/03

QA Reviewer: _____ Date: 5/12/03

EPA Approval: _____ Date: 5/19/03

Reason for and duration of modification: Site-specific procedures for photographs taken by digital cameras are different than the current SOP.

All photographs will be recorded in accordance with CDM Technical SOP 4-2, Photographic Documentation of Field Activities, with the following modifications:

Section 5.2.2, General Guidelines for Still Photography - A slate is not required for each new roll of film. The information for the slate will be recorded in the field logbook. The numbers assigned by the digital camera will be used instead of the photographer assigning the number. The caption information will either be on the back of the photograph or the photograph will be numbered or labeled and the caption information listed next to the number or label in the photograph log. On the digital photos, a caption will be included in the picture stating property address/location, date, and name of feature. All team members, as stated in the logbook, will be photographers and witnesses at the property. Slates are not required for close-up photographs. Instead the required information can be listed in the logbook or photograph log. A color strip is not required for close-up or feature photographs.

Section 5.2.4, Photographic Documentation - The name of the laboratory, time and date of drop-off, and receipt of film is not required to be recorded for this project.

Project-Specific Modification

Section 5.3.2, Archive Procedures - Digital photographs will be archived on compact discs. These discs will be assigned a document control dumber written on the disc case as well as well as the disc.

PHOTOGRAPHIC DOCUMENTATION OF FIELD ACTIVITIES

SOP 4-2
Revision: 5
Date: October 12, 2001

Prepared: David O. Johnson
Technical Review: Jackie Mosher
QA Review: Doug Updike
Approved: Signature/Date
Issued: Rose Mary Gustin 10/12/01
Signature/Date

1.0 OBJECTIVE

The purpose of this standard operating procedure (SOP) is to provide standard guidelines and methods for photographic documentation, which include still and digital photography and videotape recordings of field activities and site features (geologic formations, core sections, lithologic samples, water samples, general site layout, etc.). This document shall provide guidelines designed for use by a professional or amateur photographer. This SOP is intended for circumstances when formal photographic documentation is required. Based on project requirements, it may not be applicable for all photographic activities.

2.0 BACKGROUND

2.1 Definitions

Photographer – A photographer is the camera operator (professional or amateur) of still photography, including digital photography, or videotape recording whose primary function with regard to this SOP is to produce documentary or data-oriented visual media.

Identifier Component – Identifier components are visual components used within a photograph such as visual slates, reference markers, and pointers.

Standard Reference Marker – A standard reference marker is a reference marker that is used to indicate a feature size in the photograph and is a standard length of measure, such as a ruler, meter stick, etc. In limited instances, if a ruled marker is not available or its use is not feasible, it can be a common object of known size placed within the visual field and used for scale.

Slates – Slates are blank white index cards or paper used to present information pertaining to the subject/ procedure being photographed. Letters and numbers on the slate will be bold and written with black, indelible marking pens.

Arrows and Pointers – Arrows and pointers are markers/pointers used to indicate and/or draw attention to a special feature within the photograph.

Contrasting Backgrounds – Contrasting backgrounds are backdrops used to lay soil samples, cores, or other objects on for clearer viewing and to delineate features.

Data Recording Camera Back – A data recording camera back is a camera attachment or built-in feature that will record, at the very least, frame numbers and dates directly on the film.

2.2 Discussion

Photographs and videotape recordings made during field investigations are used as an aid in documenting and describing site features, sample collection activities, equipment used, and possible lithologic interpretation. This SOP is designed to illustrate the format and desired placement of identifier components, such as visual slates, standard reference markers, and pointers. These items shall become an integral part of the "visual media" that, for the purpose of this document, shall encompass still photographs, digital photographs, and videotape recordings (or video footage). The use of a photographic logbook and standardized entry procedures are also outlined. These procedures and guidelines will minimize potential ambiguities that may arise when viewing the visual media and ensure the representative nature of the photographic documentation.

2.3 Associated Procedures

- CDM Federal SOP 4-1, Field Logbook Content and Control

3.0 RESPONSIBILITIES

Field Team Leader (FTL) – The FTL is responsible for ensuring that the format and content of photographic documentation are in accordance with this procedure. The FTL is responsible for directing the photographer to specific situations, site features, or operations that the photographer will be responsible for documenting.

Photographer – The photographer shall seek direction from the FTL and regularly discuss the visual documentation requirements and schedule. The photographer is responsible for maintaining a logbook per Sections 5.1, 5.2.4, and 5.3.1 of this SOP.

4.0 REQUIRED EQUIPMENT

The following is a general list of equipment that may be used:

- 35mm camera or disposable single use camera (35mm or panoramic use)
- Digital camera
- Video camera
- Logbook
- Indelible black or blue ink pen
- Standard reference markers
- Slates
- Arrows or pointers

- Contrasting backgrounds
- Medium speed, or multi purpose fine-grain, color, 35 mm, negative film or slide film (project dependent)
- Data recording camera back (if available)
- Storage medium for digital camera

5.0 PROCEDURES

5.1 Documentation

A commercially available, bound logbook will be used to log and document photographic activities. Review the CDM Federal SOP 4-1 (Field Logbook Content and Control) and prepare all supplies needed for logbook entries.

Note: A separate photographic logbook is not required. A portion of the field logbook may be designated as the photographic log and documentation section.

5.1.1 Field - Health and Safety Considerations

There are no hazards that an individual will be exposed to specific to photographic documentation. However, site-specific hazards may arise depending on location or operation. Personal protective equipment used in this operation will be site-specific and dictated through requirements set by the site safety officer, site health and safety plan, and/or prescribed by the CDM Federal Corporate Health and Safety Program. The photographer should contact the site safety officer for health and safety orientation prior to commencing field activities. The site health and safety plan must be read prior to entry to the site, and all individuals must sign the appropriate acknowledgement that this has been done.

The photographer should be aware of any potential physical hazards while photographing the subject (e.g., low overhead hazard, edge of excavation).

5.2 OPERATION

5.2.1 General Photographic Activities in the Field

The following sections provide general guidelines that should be followed to visually document field activities and site features using still/digital cameras and video equipment. Listed below are general suggestions that the photographer should consider when performing activities under this SOP:

- The photographer should be prepared to make a variety of shots, from closeup to wide-angle. Many shots will be repetitive in nature or format especially closeup site feature photographs. Consideration should therefore be given to designing a system or technique that will provide a reliable repetition of performance.

- All still film photographs should be made using a medium speed, or multi purpose fine-grain, color negative film in the 35 mm format unless otherwise directed by the FTL.
- It is suggested that Kodak brand "Ektapress Gold Deluxe" film or equivalent be used as the standard film for the still photography requirements of the field activities. This film is stable at room temperature after exposure and will better survive the time lag between exposure and processing. It is suggested that film speed ASA 100 should be used for outdoor photographs in bright sunlight, ASA 200 film should be used in cloudy conditions, and ASA 400 film should be used indoors or for very low-light outdoor photographs.
- No preference of videotape brand or digital storage medium is specified and is left to the discretion of the photographer.
- The lighting for sample and feature photography should be oriented toward a flat condition with little or no shadow. If the ambient lighting conditions are inadequate, the photographer should be prepared to augment the light (perhaps with reflectors or electronic flash) to maintain the desired visual effect.
- Digital cameras have multiple photographic quality settings. A camera that obtains a higher resolution (quality) has a higher number of pixels and will store a fewer number of photographs per digital storage medium.

5.2.2 General Guidelines for Still Photography

Slate Information

When directed by the FTL, each new roll of film or digital storage medium shall contain upon the first usable frame (for film) a slate with consecutively assigned control numbers (a consecutive, unique number that is assigned by the photographer as in sample numbers).

Caption Information

All still photographs will have a full caption permanently attached to the back or permanently attached to a photo log sheet. The caption should contain the following information (digital photographs should have a caption added after the photographs are downloaded):

- Film roll control number (if required) and photograph sequence number
- Date and time
- Description of activity/item shown
- Direction (if applicable)
- Photographer

When directed by the FTL, a standard reference marker should be used in all documentary visual media. While the standard reference marker will predominantly be used in closeup feature documentation, inclusion in all scenes should be considered.

Digital media should be downloaded at least once each day.

Closeup and Feature Photography

When directed by the FTL, closeup photographs should include a standard reference marker of appropriate size as an indication of the feature size and contain a slate marked with the site name and any identifying label, such as a well number or core depth, that clearly communicates to the viewer the specific feature being photographed.

Feature samples, core pieces, and other lithologic media should be photographed as soon as possible after they have been removed from their in situ locations. This enables a more accurate record of their initial condition and color. When directed by the FTL, include a standard reference color strip (color chart such as Munsell Soil Color Chart or that available from Eastman Kodak Co.) within the scene. This is to be included for the benefit of the viewer of the photographic document and serves as a reference aid to the viewer for formal lithologic observations and interpretations.

Site Photography

Site photography, in general, will consist predominantly of medium and wide-angle shots. A standard reference marker should be placed adjacent to the feature or, when this is not possible, within the same focal plane.

While it is encouraged that a standard reference marker and caption/slate be included in the scene, it is understood that situations will arise that preclude their inclusion within the scene. This will be especially true of wide-angle shots. In such a case, the film/tape control number shall be entered in the photographic logbook along with the frame number and all other information pertinent to the scene.

Panoramic

In situations where a wide-angle lens does not provide sufficient subject detail, a single-use disposable panoramic camera is recommended. If this type of camera is not available, a panoramic series of two or three photos would be appropriate. Panoramas can provide greater detail while covering a wide subject, such as an overall shot of a site.

To shoot a panoramic series using a standard 35mm or digital camera, the following procedure is recommended.

- Use a stable surface or tripod to support the camera.
- Allow a 20 to 30 percent overlap while maintaining a uniform horizon.
- Complete 2 to 3 photos per series.

5.2.3 General Photographic Documentation Using Video Cameras

As a reminder, it is not within the scope of this document to set appropriate guidelines for presentation or "show" videotape recording. The following guidelines are set for documentary videotape recordings only and should be implemented at the discretion of the FTL.

Documentary videotape recordings of field activities may include an audio slate for all scenes. At the beginning of each video session, an announcer will recite the following information: date, time (in military units), photographer, site ID number, and site location. This oral account may include any additional information clarifying the subject matter being recorded.

A standard reference marker may be used when taking closeup shots of site features with a video camera. The scene may also include a caption/slate. It should be placed adjacent and parallel to the feature being photographed.

It is recommended that a standard reference marker and caption/slate be included in all scenes. The caption information is vital to the value of the documentary visual media and should be included. If it is not included within the scene, it should be placed before the scene.

Original videotape recordings will not be edited. This will maintain the integrity of the information contained on the videotape. If editing is desired, a working copy of the original videotape recording can be made.

5.2.4 Photographic Documentation

Photographic activities must be documented in a photographic logbook or in a section of the field logbook. The photographer will be responsible for making proper entries.

In addition to following the technical standards for logbook entry as referenced in CDM Federal SOP 4-1, the following information should be maintained in the appropriate logbook:

- Photographer name.
- If required, an entry shall be made for each new roll/tape control number assigned.
- Sequential tracking number for each photograph taken (for digital cameras, the camera-generated number may be used).
- Date and time (military time).
- Location.
- A description of the activity/item photographed.
- If needed, a description of the general setup, including approximate distance between the camera and the subject, may be recorded in the logbook.
- Record as much other information as possible to assist in the identification of the photographic document.

5.3 Post Operation

All film will be sent for development and printing to a photographic laboratory (to be determined by the photographer). The photographer will be responsible for arranging transport of the film from the field to the photographic laboratory. The photographer shall also be responsible for arranging delivery of the negatives and photographs, digital storage medium, or videotape to the project management representative.

5.3.1 Documentation

At the end of each day's photographic session, the photographer(s) will ensure that the appropriate logbook has been completely filled out and maintained as outlined in CDM Federal SOP 4-1.

5.3.2 Archive Procedures

1. Photographs and the associated set of negatives, digital media, and original unedited documentary videotape recordings will be submitted to the project files and handled according to contract records requirements. The FTL will ensure their proper distribution.

2. Completed pages of the appropriate logbook will be copied weekly and submitted to the project files.

6.0 RESTRICTIONS/LIMITATIONS

This document is designed to provide a set of guidelines for the field amateur or professional photographer to ensure that an effective and standardized program of visual documentation is maintained.

It is not within the scope of this document to provide instruction in photographic procedures, nor is it within the scope of this document to set guidelines for presentation or "show" photography.

The procedures outlined herein are general by nature. The FTL is responsible for specific operational activity or procedure. Questions concerning specific procedures or requirements should be directed to the FTL.

NOTE: Some sites do not permit photographic documentation. Check with the site contact for any restrictions.

7.0 REFERENCES

U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3*, February 2001, Appendix F.

U.S. Environmental Protection Agency, Region IV, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Athens, Georgia, May 1996.

U.S. Environmental Protection Agency, National Enforcement Investigations Center, *Multi-Media Investigation Manual*, EPA-330/9-89-003-R, Revised March 1992, p. 85.

Project-Specific Modification

SOP No.: 4-5

SOP Title: Field Equipment Decontamination at Nonradioactive Sites

Project: Libby Asbestos Remedial Investigation (RI)

Project No.: 3282-137

Client: U.S. Environmental Protection Agency

Project Manager: [signature] Date: 5/7/03

Technical Reviewer: [signature] Date: 5/7/03

QA Reviewer: [signature] Date: 5/12/03

EPA Approval: [signature] Date: 5/19/03

Reason for and duration of modification: Site-specific procedures for decontamination of Libby amphibole asbestos contaminated field equipment are different than CDM Technical SOP 4-5. These modifications are necessary for the entire duration of the project.

All equipment used to collect, handle, or measure soil samples will be decontaminated in accordance with CDM Technical SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites, with the following modifications:

Section 4.0, Required Equipment - Plastic sheeting will not be used during decontamination procedures. American Society for Testing and Materials (ASTM) Type II water will not be used. Rather, locally available deionized (DI) water will be used.

Section 5.0, Procedures - Decontamination water will not be captured and will be discharged to the ground at the property.

Section 5.6, Waste Disposal - Decontamination water will not be captured and will not be packaged, labeled, or stored as investigation-derived waste (IDW).

FIELD EQUIPMENT DECONTAMINATION AT NONRADIOACTIVE SITES

SOP: 4-5
Revision: 5
Date: December 11, 2002

Prepared: Steven Fundingsland
Technical Review: Laura Spiehal
QA Review: Matt Brookshire
Approved: 12/18/02
Signature/Date
Issued: 12/10/02
Signature/Date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to describe the procedures required for decontamination of field equipment.

2.0 BACKGROUND

2.1 Definitions

Clean - Free of visible contamination and when decontamination has been completed in accordance with this SOP.

Cross-Contamination - The transfer of contaminants through equipment or personnel from the contamination source to less contaminated or non-contaminated samples or areas.

Decontamination - The process of rinsing or otherwise cleaning the surfaces of equipment to rid them of contaminants and to minimize the potential for cross contamination of samples or exposure of personnel.

2.2 Discussion

Decontamination of field equipment is necessary to ensure acceptable quality of samples by preventing cross contamination. Further, decontamination reduces health hazards and prevents the spread of contaminants off-site.

3.0 RESPONSIBILITIES

Field Team Leader - The Field Team Leader (FTL) ensures that field personnel are trained in the performance of this procedure and that decontamination is conducted in accordance with this procedure. The FTL may also be required to collect and document rinsate samples to provide quantitative verification that these procedures have been correctly implemented.

4.0 REQUIRED EQUIPMENT

- Stiff-bristle scrub brushes
- Plastic buckets and troughs
- Laboratory-grade detergent, low phosphate (Alconox™, Liquinox ™ or similar)
- Nalgene or Teflon Sprayers or wash bottles or 2- to 5-gallon, manual-pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting
- Disposable wipes, rags or paper towels
- Potable water and/or de-ionized water of American Society for Testing and Materials (ASTM) Type II or better, as defined by ASTM Standard Specification for Reagent Water, Standard D 1193-77 (re-approved 1983)*
- Gloves, safety glasses, and other protective clothing as specified in the site-specific health and safety plan
- High-pressure pump with soap dispenser or steam-spray unit (for large equipment only)
- Appropriate decontamination solutions pesticide grade or better and traceable to a source (e.g. 10% and/or 1% nitric acid (HNO3), acetone, methanol, isopropanol, hexane)
- Tools for equipment assembly and disassembly (as required)
- 55-gallon drums or tanks (as required)
- Pallets for drums or tanks holding decontamination water (as required)

* Potable water may be required to be tested for contaminants before use. Check field plan for requirements. ASTM Type II water will include a certificate of quality.

5.0 PROCEDURES

All reusable equipment (non-dedicated) used to collect, handle, or measure samples will be decontaminated before coming into contact with any sample. Decontamination of equipment will occur either at a central decontamination station or at portable decontamination stations set up at the sampling location, drill site, or monitoring well location. The centrally-located decontamination station will include an appropriately sized bermed and lined area on which equipment decontamination will occur and shall be equipped with a collection system and storage vessels. In certain circumstances, berming is not required when small quantities of water are being generated and for some short duration field activities (i.e., pre-remedial sampling). Equipment should be transported to the decontamination station in a manner to prevent cross-contamination of equipment and/or area. Precautions taken may include enclosing augers in plastic wrap while being transported on a flatbed truck.

The decontamination area will be constructed so that contaminated water is either collected directly into appropriate containers (5-gallon buckets or steel wash tubs) or within the berms of the

decontamination area which then drains into a collection system. Water from the collection system will be transferred into 55-gallon drums or portable tanks for storage. Typically, decontamination water will be staged until sampling results or waste characterization results are obtained and evaluated and the proper disposition of the waste is determined. The exact procedure for decontamination waste disposal should be discussed in the field plan. Also, decontamination fluids, such as solvents, may need to be segregated from other investigation-derived wastes.

All items that will come into contact with potentially contaminated media will be decontaminated before use and between sampling and/or drilling locations. If decontaminated items are not immediately used, they will be covered either with clean plastic or aluminum foil depending on the size of the item. All decontamination procedures for the equipment being used are as follows:

General Guidelines

- Potable and de-ionized water should be free of all contaminants of concern. Following the field plan, analytical data from the water source may be required. If required, either existing analytical data from the water source supplier (i.e., municipality, bottled water company, de-ionized water producer) may be obtained or chemical testing may be performed on the selected source.
- Soap will be a low phosphate detergent.
- Sampling equipment that has come into contact with oil and grease will be cleaned with methanol or other approved alternative to remove the oily material. This may be followed by a hexane rinse and then another methanol rinse. Regulatory or client requirements regarding solvent use will be stated in the field plan.
- All solvents will be pesticide grade or better and traceable to a source. The corresponding lot numbers will be recorded in the appropriate logbook.
- Decontaminated equipment will be allowed to air dry before being used.
- Documentation for all cleaning will be recorded in the appropriate logbook.
- Gloves, boots, safety glasses, and any other personnel protective clothing and equipment will be used as specified in the site-specific health and safety plan.

5.1 Heavy Equipment Decontamination

Heavy equipment includes drilling rigs and backhoes. Follow these steps when decontaminating this equipment:

1. Establish a decontamination area with berms that is large enough to fully contain the equipment to be cleaned. If available, an existing wash pad or appropriate paved and bermed area may be utilized; otherwise, use one or more layers of heavy plastic sheeting to cover the ground surface and berms. All decontamination pads should be upwind of the area under investigation.

2. With the rig in place, spray areas (rear of rig or backhoe) exposed to contaminated soils using a hot water high-pressure sprayer. Be sure to spray down all surfaces, including the undercarriage.

3. Use brushes, low phosphate detergent and potable water to remove dirt whenever necessary.

4. Remove equipment from the decontamination pad and allow it to air dry before returning it to the work site.

5. Record equipment type, date, time, and method of decontamination in the appropriate logbook.

6. After decontamination activities are completed, collect all contaminated wastewater, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal as detailed in the field plan. Liquids and solids must be drummed separately.

5.2 Downhole Equipment Decontamination

Downhole equipment decontamination includes hollow-stem augers, drill pipes, casings, screens, etc. Follow these steps when decontaminating this equipment:

1. Set up a centralized decontamination area, if possible. This area should be set up to collect contaminated rinse waters and to minimize the spread of airborne spray.

2. Set up a "clean" area upwind of the decontamination area to receive cleaned equipment for air-drying. At a minimum, clean plastic sheeting must be used to cover the ground, tables, or other surfaces on which decontaminated equipment is to be placed. All decontamination pads should be upwind of any areas under investigation.

3. Place the object to be cleaned on aluminum foil or plastic-covered wooden sawhorses or other supports.

4. Using low phosphate detergent and potable water in the hot water high-pressure sprayer (or steam unit), spray the contaminated equipment. Aim downward to avoid spraying outside the decontamination area. Be sure to spray inside corners and gaps especially well. Use a brush, if necessary, to dislodge dirt.

5. If using soapy water, rinse the equipment using clean, potable water. If using hot water, the rinse step is not necessary if the hot water does not contain a detergent. If the hot water contains a detergent, this final clean water rinse is required.

6. Using the manual-pump sprayer, rinse the equipment thoroughly with de-ionized water (ASTM Type II or better).

7. Remove the equipment from the decontamination area and place in a clean area upwind to air dry.

8. Record equipment type, date, time, and method of decontamination in the appropriate logbook.

9. After decontamination activities are completed, collect all contaminated wastewaters, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal. Liquids and solids must be drummed separately.

5.3 Sampling Equipment Decontamination

Sampling equipment includes split spoons, spatulas, and bowls used for sample homogenization that directly contact sample media. Follow these steps when decontaminating this equipment:

1. Set up a decontamination line on plastic sheeting. The decontamination line should progress from "dirty" to "clean" and have an area located upwind for drying decontaminated equipment. At a minimum, clean plastic sheeting must be used to cover the ground, tables, or the surfaces on which decontaminated equipment is to be placed for drying.

2. Before washing, disassemble any items that might trap contaminants internally. Do not reassemble these items until decontamination and air-drying are complete. Wash items thoroughly in a bucket of low phosphate detergent and potable water. Use a stiff-bristle brush to dislodge any gross contamination (soil or debris).

3. Rinse the item in potable water. Rinse water should be replaced as needed, generally when cloudy.

4. Using a hand sprayer, wash bottles, or manual-pump sprayer, rinse the item with de-ionized water (ASTM Type II or better).

5. If sampling for metal analytes, rinse the item with 10% nitric acid (for stainless steel, glass, plastic, and Teflon), or 1% nitric acid (for items made of low-carbon steel) followed by a de-ionized water (ASTM Type II or better) rinse.

   NOTE: Care should be taken not to get nitric acid on skin or clothing. This step should not be used unless required by sampling needs as dictated in the field plan.

   CAUTION: Do not allow nitric acid to contact methanol or hexane. Contain nitric acid waste separate from organic solvents.

6. If sampling for organic analytes, rinse the item with methanol or approved organic solvent.

7. If required by the field plan, when sampling for polar organic compounds such as pesticides, polychlorinated biphenyls (PCBs), and fuels, rinse the item with hexane or approved alternatives, followed by a second methanol rinse.

8. Thoroughly rinse the item with de-ionized water (ASTM Type II or better).

9. Allow the item to air dry completely.

10. After drying, reassemble parts as required and wrap the item in clean plastic wrap or in aluminum foil, shiny side out.

11. Record equipment type, date, time, and method of decontamination in the appropriate logbook.

12. After decontamination activities are completed, collect all contaminated waters, used solvents and acids, plastic sheeting, and disposable gloves, boots, and clothing. Place contaminated items in properly labeled drums for disposal. Liquids and solids must be drummed separately. (Refer to site-specific plans for labeling and waste management requirements).

5.4 Pump Decontamination

Follow the manufacturer's recommendation for specified pump decontamination procedures. At a minimum follow these steps when decontaminating pumps:

1. Set up the decontamination area and separate "clean" storage area using plastic sheeting to cover the ground, tables, and other surfaces. Set up three 55-gallon drums and one or more containers of ASTM Type II water (or as specified in the field plan). One drum shall contain dilute (non-foaming) soapy water, the second drum shall contain potable water, and the third drum shall be empty to receive waste water.

2. The pump should be set up in the same configuration as for sampling. Submerge the pump intake (or the pump, if submersible) and all downhole-wetted parts (tubing, piping, foot valve) in the soapy water of the first drum. Place the discharge outlet in the wastewater drum above the level of the wastewater. Pump soapy water through the pump assembly until it discharges to the waste drum. Scrub the outside of the pump and other wetted parts with a metal brush.

3. Move the pump assembly to the potable water drum while leaving discharge outlet in the waste drum. All downhole-wetted parts must be immersed in the potable water rinse. Pump potable water through the pump assembly until it runs clear.

4. Move the pump intake to the ASTM Type II water can. Pump the ASTM Type II water through the pump assembly. Pump the volume of water through the pump specified in the field plan. Usually, three pump-and-line-assembly volumes will be required.

5. Decontaminate the discharge outlet by hand following the steps outlined in Section 5.3.

6. Remove the decontaminated pump assembly to the "clean" area and allow it to air dry upwind of the decontamination area. Intake and outlet orifices should be covered with aluminum foil to prevent the entry of airborne contaminants and particles.

7. Record the equipment type, serial number, date, time, and method of decontamination in the appropriate logbook.

5.5 Instrument Probe Decontamination

Instrument probes used for field measurements such as pH meters, conductivity meters, etc. will be decontaminated between samples and after use with ASTM Type II, or better, water.

5.6 Waste Disposal

Refer to site-specific plans for waste disposal requirements. The following are guidelines for disposing of wastes:

1. All wash water, rinse water, and decontamination solutions that have come in contact with contaminated equipment are to be handled, packaged, labeled, marked, stored, and disposed of as investigation-derived waste.

2. Small quantities of decontamination solutions may be allowed to evaporate to dryness.

3. If large quantities of used decontamination solutions will be generated, each type of waste should be separated in separate containers. This may permit the disposal of wash water and rinse water onsite or in a sanitary sewage treatment plant rather than as a hazardous waste. If an industrial wastewater treatment plant is available onsite, the disposal of acid solutions and solvent-water solutions may be permitted.

4. Unless otherwise required, plastic sheeting and disposable protective clothing may be treated as solid, non-hazardous waste.

5. Waste liquids should be sampled, analyzed for contaminants of concern in accordance with disposal regulations, and disposed of accordingly.

6.0 RESTRICTIONS/LIMITATIONS

Nitric acid and polar solvent rinses are necessary only when sampling for metals or organics respectively. These steps should not be used, unless required, because of the potential for acid burns and ignitability hazards.

If the field equipment is not thoroughly rinsed and allowed to completely air dry before use, volatile organic residue, which interferes with the analysis, may be detected in the samples. The occurrence of residual organic solvents is often dependent on the time of year sampling is conducted. In the summer, volatilization is rapid, and in the winter, volatilization is slow. Check with your EPA region, state, and client for approved decontamination solvents.

7.0 REFERENCES

Department of Energy, Hazardous Waste Remedial Actions Program, *Standard Operating Procedures For Site Characterization*, DOE/HWP-100/R1, September 1996.

Department of Energy, Hazardous Waste Remedial Actions Program, *Quality Control Requirements For Field Methods*, DOE/HWP-69/R2, September 1996.

American Society for Testing and Materials, *Standard Practice for Decontamination of Field Equipment at Nonradioactive Waste Sites*, ASTM D5088-90, June 29, 1990.

U.S. Environmental Protection Agency, Region II, "*CERCLA" Quality Assurance Manual*, Revision 1, 1989.

U.S. Environmental Protection Agency, Region IV, *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*, 1986.

U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.1, 1987.

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Project Specific Guidance
Completion of Field Sample Data Sheets (FSDS)

Project: Libby Asbestos Remedial Investigation - Remedial Investigation (RI)

Project No.: 3282-137

Document No.: CDM-LIBBY-03 Revision 1

Prepared by: Dee A. Warren Date: 4/17/03

Approved by:

Project Manager	Date 5/7/03
Technical Reviewer	Date 5/7/03
QA Reviewer	Date 5/12/03
EPA Approval	Date 5/19/03

A field sample data sheet (FSDS) must be completed using the following guidance.

Definitions:

Owner - (As it appears on the property IFF). Person who owns a residential property (may or may not be the current occupant), or the person who owns a commercial property.

Sample Coordinator - person responsible for the custody of all field paper work and samples collected

Soil Field Sample Data Sheet

Sheet No.: Pre-assigned unique sequential sheet number. Completed by sample coordinator.

Scenario No.: Scenario numbers are specific to the Phase II sampling program and do not apply to the RI. "NA" should be placed in this blank.

Field Logbook No.: The logbook number being used to record information specific to the samples on the FSDS.

Page No.: Page number in logbook on which information regarding the samples on the FSDS is recorded.

Sampling Date: Date samples are collected, in the form MM/DD/YY.

Address: (As it appears on the property IFF). The address of the property being sampled. Addresses are to be entered in the following format:

Street number - Direction - Street Name - Street Abbreviation

Where:
Street number = the number of the street address
Direction = the abbreviation of the street direction (N, S, E, or W), when applicable
Street name = correct spelling of the street name
Street abbreviation = when applicable

Road - Rd
Avenue - Ave
Street - St
Circle - Cr
Place - Pl
Boulevard - Blvd
Highway - Hwy

Examples: 510 N Mineral Ave
607 N Michigan Ave
521 Pipe Creek Rd

Business Name: (As it appears on the property IFF). If a business is located on the property, record the name. If a business is not located on the property, record NA.

Owner: (As it appears on the property IFF). Name of the property owner (not necessarily the current occupant).

Land Use: Description of land use on which property is located.

Sampling Team: Company affiliation of sampling team.

Names: Full name of all members of the sampling team.

Index ID: Sample identification (ID) number. Index ID numbers for the RI soil samples are in the form CS-#####. A set of available numbers is assigned to each sampling team by the sample coordinator.

Location ID: Unique identification number assigned to each sample location with a unique global positioning system (GPS) coordinate. For soil samples, location identifications (IDs) are in the form SP-#####. A set of available numbers is assigned to each sampling team by the sample coordinator.

Sample Group: The sample group for soil samples collected for the RI must be one of the following options:

Yard	Flower Bed
Garden	Field
Driveway	Walkway
Road	Park

Location Description: Description of the location where a soil sample was collected. If back yard, front yard, side yard, or driveway does not apply, use the other blank. If the yard sample was composed of sub-samples located in more than one yard location, circle all that apply.

Category: FS = field sample; FD = field duplicate; and FB = field blank. The field duplicate blank should be used to identify the FD of the parent FS.

Matrix Type: The samples collected for the RI will mostly be surface samples (0 to 1 or 0 to 6 inches). If a sample that is collected is not a surface sample, complete the other line using the following options: mining waste, subsurface soil, fill.

Type: Indicate the type of sample collected, grab or composite. If the sample is a composite sample, the number of sub-samples must be provided.

Time: The time of sample collection, in military time.

Top Depth: Top depth of sample in inches below the ground surface.

Bottom Depth: Bottom depth of sample in inches below the ground surface.

Field Comments: Any information specific to a sample. If vermiculite is present, this must be noted in the field comments section.

Entered: Completed by Volpe personnel at time of data entry.

Validated: Completed by Volpe personnel at time of data entry check.

Completed by: Initials of field team member that completes the FSDS.

QC by: Initials of field team member that completes QC check of FSDS.

Dust Field Sample Data Sheet

Sheet No.: Pre-assigned unique sequential sheet number. Completed by sample coordinator.

Scenario No.: Scenario numbers are specific to the Phase II sampling program and do not apply to the RI. "NA" should be placed in this blank.

Field Logbook No.: The logbook number being used to record information specific to the samples on the FSDS.

Page No.: Page number in logbook on which information regarding the samples on the FSDS is recorded.

Sampling Date: Date samples are collected, in the form MM/DD/YY.

Address: (As it appears on the property IFF). The address of the property being sampled. Addresses are to be entered in the following format:

Street number - Direction - Street Name - Street Abbreviation

Where:
Street number = the number of the street address
Direction = the abbreviation of the street direction (N, S, E, or W), when applicable
Street name = correct spelling of the street name
Street abbreviation = when applicable

Road - Rd
Avenue - Ave
Street - St
Circle - Cr
Place - Pl
Boulevard - Blvd
Highway - Hwy

Examples: 510 N Mineral Ave
607 N Michigan Ave
521 Pipe Creek Rd

Business Name: (As it appears on the property IFF). If a business is located on the property, record the name. If a business is not located on the property, record NA.

Owner: (As it appears on the property IFF). Name of the property owner (not necessarily the current occupant).

Land Use: Description of land use on which property is located.

Sampling Team: Company affiliation of sampling team.
Names: Full name of all members of the sampling team.

Index ID: Sample identification (ID) number. Index ID numbers for the RI dust samples are in the form 1-#####. A set of available numbers is assigned to each sampling team by the sample coordinator.

Location ID: Unique identification number assigned to each sample location with a unique global positioning system (GPS) coordinate. For dust samples, location identifications (IDs) are in the form BD-#####. The location ID for dust samples is the BD number of the structure the dust sample is collected in. A set of available numbers is assigned to each sampling team by the sample coordinator.

Matrix Type: Circle the structure type in which the sample is collected. If the best description of the structure is not an option, right a description in the blank provided.

Sample Group: Circle the floor/level the dust sample was collected on. If the best description of the floor/level is not an option, right a description in the blank provided.

Location Description: Circle the location the dust sample was collected per the dust sampling protocol. Circle all locations that apply to the sample. If the best description of the location is not an option, right a description in the blank provided.

Category: FS = field sample or blank. It the cassette was used to collect a sample, circle FS. If the cassette will be submitted as a blank, circle blank.

Sample Area: Circle the amount of area sampled with the cassette.

Filter Diameter: Circle the appropriate filter diameter.

Pore Size: Circle the appropriate pore size.

Flow Meter Type: Circle the type of flow meter used to calibrate the pump flow rate.

Flow Meter ID No.: Record the identification number of the flow meter used to calibrate the pump flow rate.

Pump ID No.: Record the identification number of the pump used to collect the sample.

Start Time: Record the starting time of each sample aliquot collection, in military time.

Start Flow: Record the starting pump flow rate for the sample colleted in Liters per minute (L/min).

Stop Time: Record the stopping time of each sample aliquot collection, in military time.

Stop Flow: Record the stopping pump flow rate for the sample colleted in minute L/min.
Pump Fault: If the pump faulted during sample collection, circle Yes. If the pump did not fault during sample collection, circle No.

Field Comments: For each 100cm2 aliquot locations, record the specific location sampled.

Entered: Completed by Volpe personnel at time of data entry.

Validated: Completed by Volpe personnel at time of data entry check.

Completed by: Initials of field team member that completes the FSDS.

QC by: Initials of field team member that completes QC check of FSDS.

Completion of Property Information Field Form

Project: Libby Asbestos Remedial Investigation - Contaminant Screening Study (CSS)

Project No.: 3282-137

Document No.: CDM-LIBBY-04 Revision 1

Prepared by: Dee Warren, Project Scientist — 4/21/03 Date

Approved by: _____ Project Manager — 5/7/03 Date

_____ Technical Reviewer — 5/7/03 Date

_____ QA Reviewer — 5/13/03 2 kma Date

_____ EPA Approval — 5/19/03 Date

An information field form (IFF) is to be completed for each structure located on a property. Three IFFs will be used: (1) primary structure and property assessment information field form (Primary IFF), (2) secondary structure information field form (Secondary IFF), and (3) primary structure and property assessment supplemental information field form (SIFF). The IFFs are completed from both interviews with the occupant/owner and visual inspection of the structures and surrounding properties and are used to facilitate the information-gathering process (interview and visual inspection) of properties during the contaminant screening study (CSS).

Definitions:

Primary structure - Refers to the main inhabitable structure on a property or the main commercial structure on a property.

Secondary structure - Refers to structures other than the primary structure located on a property (i.e., shed, barn, detached garage with an attic, etc.). Attached garages are considered part of the primary structure.

Owner - Refers to the person who owns a residential property (may or may not be the current occupant) or person who owns a commercial property.

Each entry on the IFF should be completed following the guidance procedure, and any notes on each item should be written in the notes column to the right of each data item. The IFF type the item refers to is shown following the description of the data to be entered.

Header Information

BD#: Refers to the location identification (ID) number of the structure the IFF is being completed for. The field team obtains a list of available numbers from the sample coordinator. The building number is the unique identification number of the building where the information was collected. For apartment buildings or commercial building with more than one occupant, an IFF will be completed for each occupant. The BD number placed on each IFF will be the BD number unique to that entire building. The apartment or suite number for which the IFF is being completed will be placed in the structure description field of the IFF. For trailer parks where there are multiple structures on the same property, each will be given a unique BD number and the lot number will be placed in the address (e.g., 576 Reese Ct #33). (Primary IFF, Secondary IFF, SIFF)

Phase I Background IFF (BIFF) No.: Refers to the BIFF number completed during phase I dust sampling. (SIFF)

Soil samples collected: Provide the date of CSS soil sample collection. This item is to be completed at the time of soil sample collection. (Primary IFF, Secondary IFF, SIFF)

Field Logbook No.: The number of the field logbook that is used to record information specific to the property being assessed on the IFF. (Primary IFF, Secondary IFF, SIFF)

Page No.: The page numbers in the logbook that contain information specific to the property being assessed on the IFF. (Primary IFF, Secondary IFF, SIFF)

Site Visit Date: Date of site visit, in the form MM/DD/YY. (Primary IFF, Secondary IFF, SIFF)

Address: The address of the property being assessed on the IFF. Addresses are to be entered in the following format detailed below. (Primary IFF, Secondary IFF, SIFF)

Street number - Direction - Street Name - Street Abbreviation

Where:

Street number = the number of the street address
Direction = the abbreviation of the street direction (N, S, E, or W), when applicable
Street name = correct spelling of the street name
Street abbreviation = when applicable
Road - Rd

Avenue - Ave
Street - St
Circle - Cr
Place - Pl
Boulevard - Blvd
Highway - Hwy

Examples: 510 N Mineral Ave
1616 Rainy Creek Rd
521 Pipe Creek Rd

Structure Description: Description of the structure specific to the IFF (i.e., house, trailer, garage, shed, barn). (Primary IFF, Secondary IFF, SIFF)

Occupant: Name of current occupants of the primary structure. In the case of a commercial property, the occupant information would not be completed. (Primary IFF, Secondary IFF, SIFF)

Occupant Phone Number: Phone number of occupant of the primary structure. (Primary IFF, Secondary IFF, SIFF)

Owner: Only needs to be completed if the owner of the structure or property is different than the current occupant (i.e., renter). Required for commercial properties. (Primary IFF, Secondary IFF, SIFF)

Owner Phone Number: Phone number of the owner of the property. For residential properties, only complete if the owner is different than the current occupant. Required for commercial properties. (Primary IFF, Secondary IFF, SIFF)

Business Name: Name of business located on property. (Primary IFF, Secondary IFF, SIFF)

Sampling Team: Full name and company of each member of the team assessing the property (i.e., members sampling and/or completing IFF). (Primary IFF, Secondary IFF, SIFF)

Field Form Check Completed by (100% of forms): To be signed, after IFF is checked by the field team member not completing the IFF. (Primary IFF, Secondary IFF, SIFF)

Screening Field check Completed by (2% of forms): To be signed, after IFF is checked by the CSS task leader. (Primary IFF, Secondary IFF, SIFF)

House Attributes

Property Description: Description of the property specific to the IFF being completed. Indicate all that apply. (Primary IFF, Secondary IFF)

Surrounding Land Use: Description of the land use groups surrounding the property specific to the IFF being completed. Indicate all that apply. (Primary IFF, Secondary IFF)

Year of Construction: Year structure was constructed. If occupant and/or owner do not know what year the structure was complete, choose unknown. (Primary IFF, Secondary IFF)

Square Footage: Calculated from the field diagram or estimated from occupant/owner interview. (Primary IFF, Secondary IFF)

Construction Material: Material structure is constructed from. If other than wood, masonry, or stone, choose other and provide a description. (Primary IFF, Secondary IFF)

Number of Floors Above Ground: Number of floors above ground specific to the structure that is assessed on the IFF. If other than 1, 2, or 3, provide number of floors in blank. The number of floors above ground should include the attic only if it is used as a living space. (Primary IFF, Secondary IFF)

Number of Rooms Per Floor Above Ground: Number of rooms per floor that is above ground. Enter number of rooms per floor next to the floor number. If more than three floors are present, provide the information on the blank. (Primary IFF, Secondary IFF)

Basement: If a basement is present, choose yes. If a basement is not present, choose no. Basement refers to a room below ground level that a person can enter and stand upright (i.e., a crawl space is not a basement). (Primary IFF, Secondary IFF)

Heating Source: Method by which heat is produced in the structure. If a method other than wood/coal, electric, or propane/gas is used as a heating source, choose other and provide a description. (Primary IFF, Secondary IFF)

Heat Distribution: Method by which heat is distributed throughout the structure. Occupant and/or owner should be able to provide this information. (Primary IFF, Secondary IFF)

Was the residence/building remodeled? Provide yes or no as an answer. If yes, provide years since remodeling and location of remodeling. If occupant/owner is unsure, provide a note in the provided space. (Primary IFF, Secondary IFF)

Has resident/business purchased any Libby vermiculite materials from W.R. Grace in the past? Based on occupant/owner interview. Provide yes or no as an answer. If occupant/owner is unsure, provide a note in the provided space. (Primary IFF)

Has the property at this location been used for a for-profit enterprise of distributing, treating, storing, or disposing of Libby vermiculite? Based on occupant/owner

interview. Provide yes or no as an answer. If occupant/owner is unsure, provide a note in the provided space. (Primary IFF)

CSS Assessment

Occupant Information: Provide date verbal interview is completed. (Primary IFF, Secondary IFF, SIFF)

Is there any knowledge of former miners, close relatives of miners, or any highly exposed persons living or visiting the property? Circle the answer that applies based on the verbal interview. If the answer is unknown, state why in the comments section. (Primary IFF, Secondary IFF, SIFF)

Is the resident, past or present, diagnosed with an asbestos-related disease? Circle the answer that applies based on the verbal interview. If the answer is unknown, state why in the comments section. (Primary IFF, Secondary IFF, SIFF)

Indoor Information: Provide date indoor visual inspection was completed. (Primary IFF, Secondary IFF, SIFF)

Does the interior have vermiculite attic insulation? Circle the answer that applies based on the visual inspection. If the answer is unknown, state why in the comments section. (Primary IFF, Secondary IFF, SIFF)

Did the interior ever have vermiculite attic insulation? Circle the answer that applies based on the visual inspection and verbal interview. If the answer is unknown, state why in the comments section. NA applies if the attic currently has VCI. (Primary IFF, Secondary IFF, SIFF)

Are there vermiculite additives in any of the building materials? Circle the answer that applies based on the visual inspection and verbal interview. If vermiculite was used as an additive, provide the type of material and its location. If the answer is unknown, state why in the comments section. (Primary IFF, Secondary IFF, SIFF)

Location of indoor vermiculite: Circle all locations where indoor vermiculite was observed. If the best description of the location is not listed, provide a description in the space provided. If vermiculite is observed in the living space, circle the location (floor of structure) the vermiculite was observed on and provide the specific location in the area provided (i.e., first floor bathroom). (Primary IFF, Secondary IFF, SIFF)

Outdoor Information: Provide date outdoor visual inspection was completed. (Primary IFF, Secondary IFF, SIFF)

Location of outdoor vermiculite: Circle all locations where outdoor vermiculite was observed. If the best description of the location is not list, provide a description in the space provided. (Primary IFF, Secondary IFF, SIFF)

Overall Assessment: Provide date verbal interview, indoor visual inspection, outdoor visual inspection was completed. (Primary IFF, SIFF)

Are primary source materials present at the property? Circle the answer that applies based on the visual inspection and verbal interview. Vermiculite in secondary structures should be included in this answer. (Primary IFF, SIFF)

Where are primary source materials located? Circle the answer that applies based on the visual inspection and verbal interview. Vermiculite in secondary structures should be included in this answer. NA applies if no primary source materials are located at the property. (Primary IFF, SIFF)

Additional Information

Any information concerning the presence of sources that are identified in the occupant/owner interview and any partial access or sample collection issues. On Primary IFFs, indicate which secondary structures are present on the property and do not contain vermiculite. (Primary IFF, Secondary IFF, SIFF)

Field Diagram of Property

To include location of all important features (i.e., drainage, trees, structures, flowerbeds, utility poles, known underground utilities, suspected Libby amphibole source areas, sample locations, etc.). A north arrow and location of streets adjacent to the property should also be included. (Primary IFF, SIFF)

Site-Specific Standard Operating Procedure for Soil Sample Collection

SOP No: CDM-LIBBY-05 Revision 1

Project: Libby Asbestos Remedial Investigation - Contaminant Screening Study (CSS)/Remedial Investigation (RI)

Project Number: 3282-137

Prepared by: Thomas E. Cook, Environmental Scientist — 4/3/02 Date

Dee A. Warren, Revision 1, Project Scientist — 4/17/03 Date

Approved by: _____ Project Manager — 5/7/03 Date

_____ Technical Reviewer — 5/7/03 Date

_____ QA Reviewer — 5/12/03 Date

_____ EPA Approval — 5/19/03 Date

Section 1
Purpose

The purpose of this standard operating procedure (SOP) is to provide a standardized method for surface soil sampling to be used by employees of EPA Region VIII contractors/subcontractors supporting EPA Region VIII CSS and RI activities for the Libby Asbestos Project in Libby, Montana. This SOP describes the equipment and operations used for sampling surface soils in residential areas, which will be submitted for the analysis of Libby amphiboles. The EPA Region VIII remedial project manager, or on-scene coordinator must approve site-specific deviations from the procedures outlined in this document prior to initiation of the sampling activity. This SOP provides the protocols for composite surface-soil sampling.

Section 2
Responsibilities

Successful execution of the sampling and analysis plan (SAP) requires a clear hierarchy of assigned roles with different sets of responsibilities associated with each role.

The CSS/RI task leader is responsible for overseeing the CSS/RI residential surface soil sampling activities. The CSS/RI task leader is also responsible for checking all work performed and verifying that the work satisfies the specific tasks outlined by this SOP and the SAP. It is the responsibility of the CSS/RI task leader to communicate with the field personnel specific collection objectives and anticipate situations that require any deviation from the SAP. It is also the responsibility of the CSS/RI task leader to communicate the need for any deviations from the SAP with the appropriate EPA Region VIII personnel (remedial project manager or on-scene coordinator).

Field personnel performing soil sampling are responsible for adhering to the applicable tasks outlined in this procedure while collecting samples at residences. The field personnel should have limited discretion with regard to collection procedures but should exercise judgment regarding the exact location of the sample point, within the boundaries outlined by the CSS/RI task leader.

Section 3
Equipment

- Sample container - The sample container will consist of quart-sized zip-top plastic bags (2 per sample).
- Trowel - For collecting surface soil samples.
- Bulb planter - For collecting surface soil samples.
- Shovel - For collecting surface soil samples.
- Stainless steel mixing bowl - Used to mix and homogenize composite soil samples after collection.
- Gloves - For personal protection and to prevent cross-contamination of samples. May be plastic or latex. Disposable, powderless.
- Field clothing and personal protective equipment (PPE) - As specified in the health and safety plan (HASP).
- Field sprayers - For decontaminating nondisposable sampling equipment between samples will be used.
- Silica sand - For field equipment blank quality control (QC) samples.
- Wipes - Disposable, paper. Used to clean and decontaminate sampling equipment.
- Field logbook -Used to record progress of sampling effort and record any problems and field observations.

- Information Field Forms (IFF) - Used to record information such as property detail, location of amphibole contamination, and estimated quantities.
- Field Sample Data Sheet (FSDS) - Used to record soil sample information.
- Permanent marking pen - Used to label sample containers.
- Index ID stickers - Used to label sample containers.
- Plastic buckets - Used to wash nondisposable field equipment between samples.
- Trash bag - Used to dispose gloves and wipes.
- Cooler - Used to store samples while in the field.
- Chain of Custody Record - For ensuring custody of samples until shipping.
- Custody Seals - For ensuring custody of samples during shipping.

Section 4
Sampling Pattern

Each property will be segregated into land use areas for sampling purposes. Use areas may include but not be limited to:

- Yard (grassy area)
- Landscaped area
- Garden
- Fill area
- Driveway

Properties with grassy areas greater than ½ acre in size will be sectioned off into separate zones for increased accuracy in characterization. Sectioning properties into additional zones will be at the discretion of the CDM field team leader but consistent among the teams. This segregation will be accomplished so that a five-point composite sample will characterize the section. A five-point composite sample will be collected for land areas less than or equal to 1/8 of an acre.

Up to five composite soil samples will be collected at each property. Composite sampling requires soil collection from multiple (sub-sample) points. Composite samples will be collected from similar land use areas (i.e., yard, garden, stockpiled soil, etc.). Additional composite or grab samples may be collected dependent upon site conditions (i.e., multiple land use areas, zones, etc.). Conversely, not all land areas previously mentioned will be applicable at every property and fewer (not less than two) will be collected.

For non-disturbed areas (i.e., yard), composite samples will be collected from 0 to 1 inch (in.). For disturbed areas (i.e., driveway garden, fill area, landscaped areas, etc.), composite samples will be collected from 0 to 6 in. All composite soils samples will have five subsamples (i.e., five-point composite sample) of approximately equal size.

If vermiculite is observed in large land use areas (driveway and yards), one sample should be collected from each area. Any other land use areas where vermiculite product is visible will not be sampled. Instead, the location will be recorded in the field logbook and on the IFF.

Section 5
Sample Collection

Don the appropriate PPE as specified in the HASP. A new pair of plastic gloves are to be worn for each sample collected. Segregate land use areas on the property as described in Section 4. Visually inspect each land use area for visual vermiculite product. To reduce dust generation during sampling, use a sprayer with deionized water to wet each sample point prior to collection. Use the trowel to check beneath the surface soil layer, but do not advance more than 6 in. If visible vermiculite is observed, record information in the appropriate field forms and do not collect a sample from that land use area. If visible vermiculite is not observed, proceed with sample collection.

Within each land use area, select five subsample locations equidistant from each other. These five subsample locations will comprise the five-point composite sample for that land use area. All composite subsamples will originate from the same land use area. For example, do not mix subsamples from garden areas with subsamples from grassy areas.

Clean the subsample locations of twigs, leaves, and other vegetative material that can be easily removed by hand. Using the trowel, excavate a hole in the soil approximately 2 in. in diameter and 1 in. deep (6 in. for disturbed areas) while placing the excavated material directly inside the mixing bowl. The sides of the excavated hole should be close to vertical to avoid sampling that is biased in favor of the upper layer of soil. Repeat this step for each subsequent subsample until the appropriate number of composite subsamples has been collected.

Homogenize the sample using the sampling trowel. Once the sample is homogenized, fill the zip-top plastic bag to 1/3rd full (approximately 2000 grams). Affix the sample index identification (ID) sticker to the inside of the bag and write the index ID number on the outside of the bag. Double bag the sample and repeat the labeling process for the outer bag. Decontaminate equipment between composite samples as described in Section 8.

Repeat steps outlined above until all samples from a property have been collected.

Soil field duplicate samples will be collected at a rate of 1 per 20 (5 percent) of the field samples. Field duplicate samples will be collected as samples co-located in the same land use area. The duplicate will be collected from the same number of subsamples as the parent sample, but the subsample locations of the duplicate sample will be randomly located in the use area. These samples will be independently collected with separate sampling equipment. These samples will be used to determine the variability of sample results in a given land use are. These samples will not be used to determine variability in sampling techniques.

Section 6
Site Cleanup

Specific instruction regarding site cleanup of investigation-derived waste (IDW) is included in CDM SOP 2-2, Guide to Handling Investigation-Derived Waste, with modification. In general, replace soil plug with excess sample volume. The soil should be placed back into the hole and tamped down lightly. If sandy areas such as playgrounds are sampled, refilling the soil plug is not necessary.

Rinse water, the roots of vegetation removed during sampling, and any excess soil volume may be disposed of on the ground as specified in the SAP.

Section 7
Record Keeping and Quality Control

A field logbook should be maintained by each individual or team that is collecting samples as described in the SAP. The SAP will detail specific conditions (SOP 4-1), which require attention, but at a minimum the following information should be collected:

- Date
- Time
- Team members
- Weather conditions
- PPE used
- Locations of any samples and subsamples that could not be acquired
- Descriptions of any deviations to the SAP and the reason for the deviation

Complete the IFF and FSDS for each property/sample.

Quality control samples will include:

- Field duplicates
- Equipment blank samples

Detailed information on QC sample collection and frequency is included in the SAP.

Section 8
Decontamination

All sampling equipment must be decontaminated prior to reuse. Specific instructions on sample equipment decontamination are included in CDM SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites, with modification. In general, the procedure to decontaminate all equipment is outlined below:

Decontamination procedures for soil sampling equipment will follow these steps:

- Remove all gross contamination with plastic brush
- Use DI water and a plastic brush to wash each piece of equipment
- Remove excess water present on the equipment by shaking
- Use a paper towel to dry each piece of equipment
- Wrap dried equipment in aluminum foil

Once a week all soil sampling equipment will be cleaning using Alconox and DI water.

Spent wipes, gloves, and PPE must be disposed or stored properly as specified in the SAP.

Section 9
Glossary

Sampling and Analysis Plan (SAP) - The written document that spells out the detailed site-specific procedures to be followed by the project leader and the field personnel.

Sample Point - The actual location at which the sample is taken. The dimension of a sample point is 2 in. across by 1 in. deep (6 in. for disturbed areas).

Composite Sampling - A sample program in which multiple sample points are compiled together and submitted for analysis as a single sample.

Land Use Area - A section of property segregated by how the property owner uses the section. For example, garden landscaped areas are individual land use areas. Grassy areas (i.e., lawn) are also considered to be a separate land use area.

Appendix D

Record of Deviation/Record of Modification Form

Record of Deviation/ Request for Modification

to the

Libby Sampling and Quality Assurance Project Plan

Field Activities

Instructions to Requester: Fax to contacts at bottom of form for review and approval. File approved copy with Data Manager and fax copy to SRC.

Project QAPP (circle one): PE Study Part a (approved 6/00), b (approval pending), c (approval pending)
Phase I (approved 4/00) Phase II (approved 2/01)
Removal Action (approved 7/00) CSS (approval 5/02)

Scenario No. (circle one): 1 2 3 4 NA

Requester: _____ Title: _____
Company: _____ Date: _____

Description of Deviation:

_____
_____

Field Logbook and page number deviation is documented on: _____
Reason for Deviation:

_____
_____

Potential Implications of this Deviation:

_____
_____

Duration of Deviation (circle one):

Temporary Date(s): _____
Resident address(es): _____
_____

Permanent (complete Proposed Modification Section)

Proposed Modification to SQAPP (attach additional sheets if necessary; state section and page numbers of SQAPP when applicable):

_____
_____
_____

Technical Review: _____ Date: _____
(Volpe Project Manager or designate)

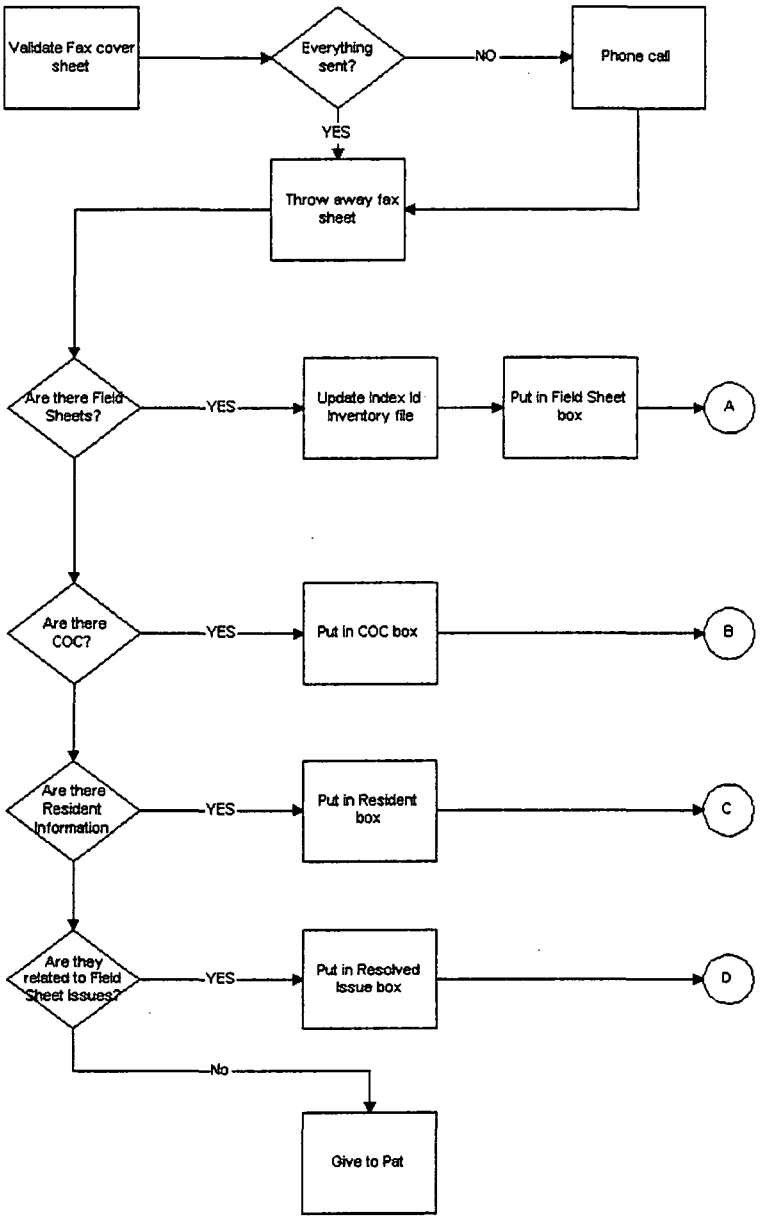
Quality Assurance Review and Approval: _____ Date: _____
(Quality Assurance Coordinator or designate)

Approved By: _____ Title: _____ Date: _____
(USEPA OSC or SSC)

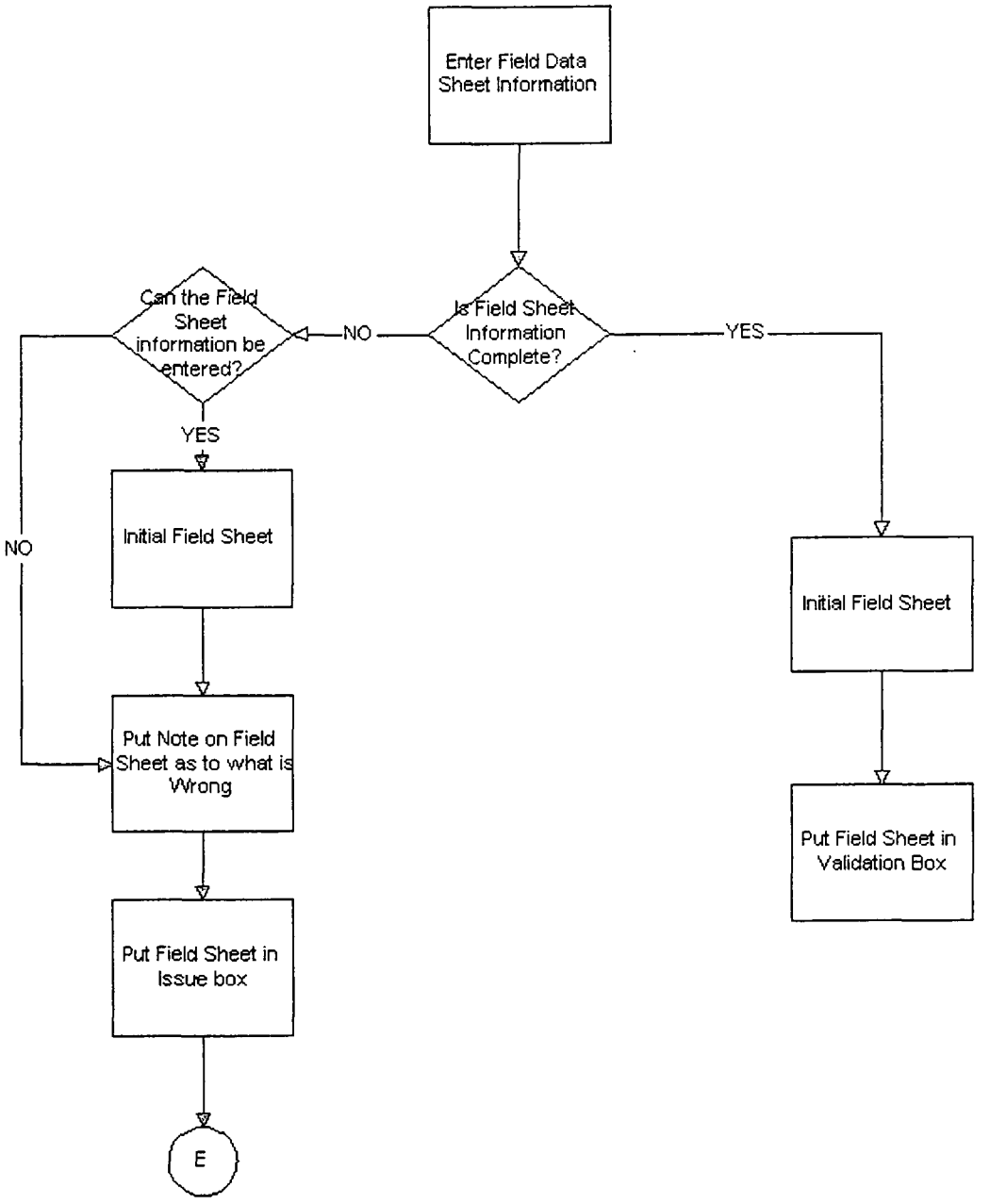
Appendix E

Volpe Center Paperwork Flow Process

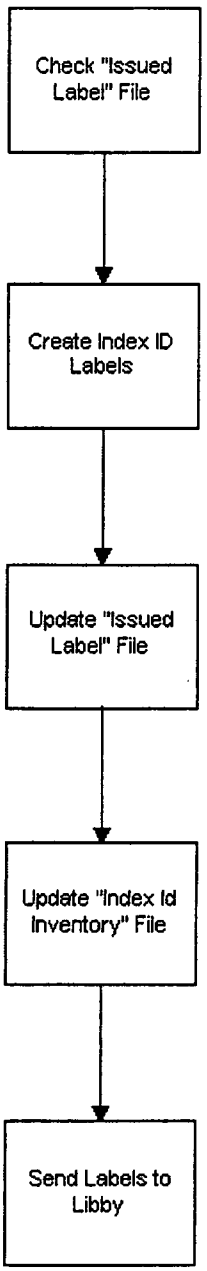
Fax Process


Validate Fax cover sheet
Everything sent?
NO
Phone call
YES
Throw away fax sheet
Are there Field Sheets?
YES
Update Index Id Inventory file
Put in Field Sheet box
A
Are there COC?
YES
Put in COC box
B
Are there Resident Information
YES
Put in Resident box
C
Are they related to Field Sheet Issues?
YES
Put in Resolved Issue box
D
No
Give to Pat

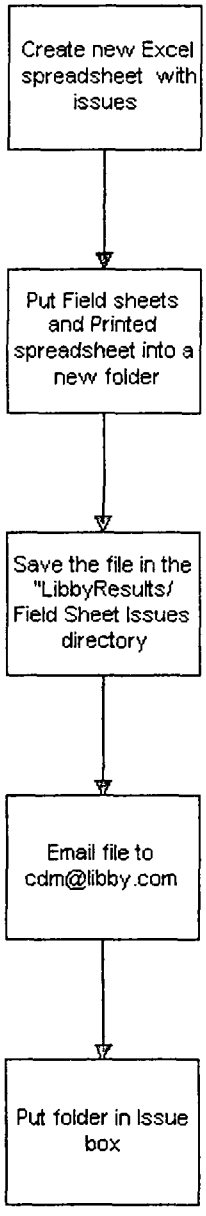
A - Field Sheet Process



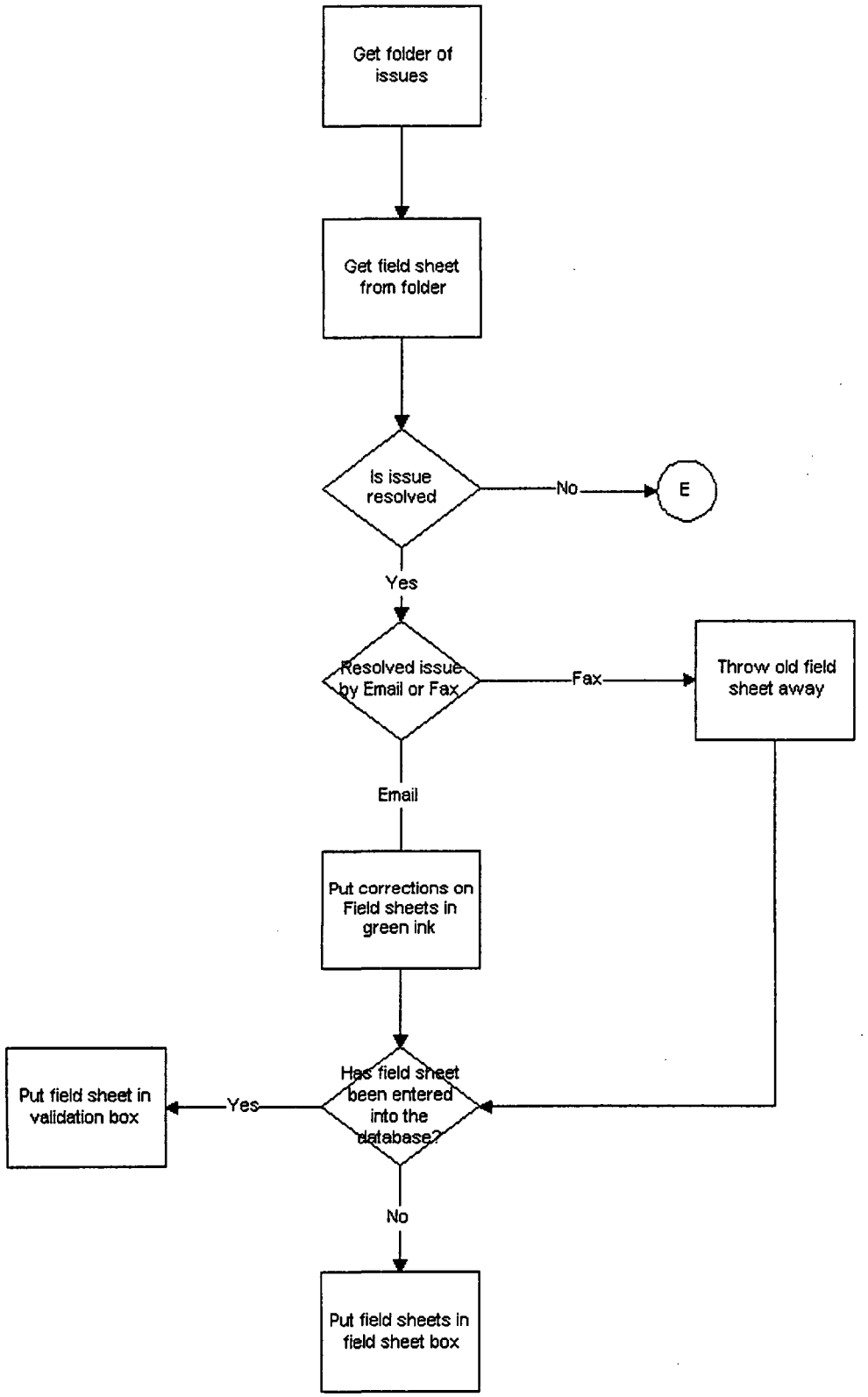
Index Label Process



E - Issue Process



D - Resolve Issue Process



Appendix F

Laboratory Training Outline

TRAINING OUTLINE
(Laboratory)

TRAINING ISSUES OF CONCERN

1. **Analytical Procedures**
   - Method Variances
   - QC Requirements
   - Visual References

2. **Mineralogy Recognition & Definition**
   - Libby-Type Amphibole
     - (Winchite, Richterite, Tremolite/Actinolite, Edenite/Ferroedenite, & Magnesio-arfvedsnoite)

3. **Reporting Requirements**
   - Data Entry & QA
   - Electronic & Hardcopy Submittal

4. **Operational Procedural Requirements**
   - Sample Logging
   - What to include in hardcopy laboratory reports
     - spectra, count sheets, QC sheets, etc.
   - Notification of any WR Grace conflicts of interests (as they occur)
   - Sample Archiving

TRAINING APPROACH

1. Repetition of July 2001 EDS Spectra Characteristic Study for Libby-Type Amphiboles

Each laboratory will need to demonstrate an understanding of the definition of a Libby-type amphibole (LA) and an ability to recognize LAs. This will be accomplished by repeating the EDS Spectra Characterization Study, which was performed in July 2001 by Reservoirs Environmental Services, Inc. (RESI) and EMSL Analytical, Inc. (EMSL). The laboratory will need to perform all study analysis prior to being visited by a Lab Mentor (see Training Approach 2 below). The lab mentor (while on-site) will review the Laboratory's plotted EDS results to insure that they are consistent with the findings of July 2001. Following the mentor's review, the mentor will provide a recommendation regarding the laboratory's understanding and whether there are any reasons for the laboratory to repeat the study (partial or complete).

2. Lab Mentoring Program

Senior personnel from RESI and EMSL that have been involved with providing analytical support on the Libby Asbestos project (for at least one year) will act as "Mentors" to new laboratories, as requested. These lab mentors will travel to the new laboratory and will work with the laboratory's personnel to address the issues as listed above under "Training Issues of Concern". The mentors will follow a training checklist, which will be prepared by RESI in collaboration with Volpe, CDM, EMSL, and EPA. Upon completion of the mentor's visit the mentor will document their review with a brief one-page summary and their recommendation as to whether the laboratory is ready to start accepting project samples or whether additional follow-up training is required. The mentor's review summary will become part of CDM's contract file.

3. Re-analysis of Project Samples

While the lab mentors are on-site they will observe laboratory personnel as they prep and analyze previously analyzed project samples for each method being used in support of the project. In the case of the ISO 10312 method, the laboratory shall prepare samples via both direct and indirect preps. The mentor will verify the use of and instruct the laboratory on project specific variances to insure consistency. In addition, in the mentor's presence, the laboratory will perform an ISO recount same of three previously analyzed project grids (which contained fibers).

OTHER

1. Provide for informational purposes and reference copies of all QAPPs and SAPs.
2. Laboratory will participate in all scheduled weekly laboratory telecons.
3. Participation in Round Robin PE Study and/or other periodic blind QA/QC samples.

Appendix G

ASTM Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations. Designation Method D5755-95

Designation: D 5755 – 95

Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations[1]

This standard is issued under the fixed designation D 5755; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers a procedure to (*a*) identify asbestos in dust and (*b*) provide an estimate of the concentration of asbestos in the sampled dust reported as the number of asbestos structures per unit area of sampled surface.

1.1.1 If an estimate of the asbestos mass is to be determined, the user is referred to Test Method D 5756.

1.2 This test method describes the equipment and procedures necessary for sampling, by a microvacuum technique, non-airborne dust for levels of asbestos structures. The non-airborne sample is collected inside a standard filter membrane cassette from the sampling of a surface area for dust which may contain asbestos.

1.2.1 This procedure uses a microvacuuming sampling technique. The collection efficiency of this technique is unknown and will vary among substrates. Properties influencing collection efficiency include surface texture, adhesiveness, electrostatic properties and other factors.

1.3 Asbestos identified by transmission electron microscopy (TEM) is based on morphology, selected area electron diffraction (SAED), and energy dispersive X-ray analysis (EDXA). Some information about structure size is also determined.

1.4 This test method is generally applicable for an estimate of the concentration of asbestos structures starting from approximately 1000 asbestos structures per square centimetre.

1.4.1 The procedure outlined in this test method employs an indirect sample preparation technique. It is intended to disperse aggregated asbestos into fundamental fibrils, fiber bundles, clusters, or matrices that can be more accurately quantified by transmission electron microscopy. However, as with all indirect sample preparation techniques, the asbestos observed for quantification may not represent the physical form of the asbestos as sampled. More specifically, the procedure described neither creates nor destroys asbestos, but it may alter the physical form of the mineral fibers.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 1193 Specification for Reagent Water[2]

D 1739 Test Method for the Collection and Measurement of Dustfall (Settleable Particulate Matter)[3]

D 3195 Practice for Rotameter Calibration[2]

D 3670 Guide for Determination of Precision and Bias of Methods of Committee D-22[3]

D 5756 Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Mass Concentration[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *asbestiform*—a special type of fibrous habit in which the fibers are separable into thinner fibers and ultimately into fibrils. This habit accounts for greater flexibility and higher tensile strength than other habits of the same mineral. For more information on asbestiform mineralogy, see Refs (1),[4] (2) and (3).

3.1.2 *asbestos*—a collective term that describes a group of naturally occurring, inorganic, highly fibrous, silicate dominated minerals, which are easily separated into long, thin, flexible fibers when crushed or processed.

DISCUSSION—Included in the definition are the asbestiform varieties of: serpentine (chrysotile); riebeckite (crocidolite); grunerite (grunerite asbestos); anthophyllite (anthophyllite asbestos); tremolite (tremolite asbestos); and actinolite (actinolite asbestos). The amphibole mineral compositions are defined according to nomenclature of the International Mineralogical Association (3).

Asbestos	Chemical Abstract Service No.[5]
Chrysotile	12001-29-5
Crocidolite	12001-28-4
Grunerite Asbestos	12172-73-5
Anthophyllite Asbestos	77536-67-5
Tremolite Asbestos	77536-68-6
Actinolite Asbestos	77536-66-4

3.1.3 *fibril*—a single fiber that cannot be separated into

[1] This test method is under the jurisdiction of ASTM Committee D-22 on Sampling and Analysis of Atmospheres and is the direct responsibility of Subcommittee D22.07 on Sampling and Analysis of Asbestos.

Current edition approved August 15, 1995. Published October 1995.

[2] *Annual Book of ASTM Standards*, Vol 11.01.

[3] *Annual Book of ASTM Standards*, Vol 11.03.

[4] The boldface numbers in parentheses refer to the list of references at the end of this test method.

[5] The non-asbestiform variations of the minerals indicated in 3.1.3 have different Chemical Abstract Service (CAS) numbers.

smaller components without losing its fibrous properties or appearance.

3.2 *Descriptions of Terms Specific to This Standard:*

3.2.1 *aspect ratio*—the ratio of the length of a fibrous particle to its average width.

3.2.2 *bundle*—a structure composed of three or more fibers in a parallel arrangement with the fibers closer than one fiber diameter to each other.

3.2.3 *cluster*—a structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group; groupings of fibers must have more than two points touching.

3.2.4 *debris*—materials that are of an amount and size (particles greater than 1 mm in diameter) that can be visually identified as to their source.

3.2.5 *dust*—any material composed of particles in a size range of ≤1 mm and large enough to settle by virtue of their weight from the ambient air (see definition for settleable particulate matter in Test Method D 1739).

3.2.6 *fiber*—a structure having a minimum length of 0.5 µm, an aspect ratio of 5:1 or greater, and substantially parallel sides (4).

3.2.7 *fibrous*—of a mineral composed of parallel, radiating, or interlaced aggregates of fibers, from which the fibers are sometimes separable. That is, the crystalline aggregate may be referred to as fibrous even if it is not composed of separable fibers, but has that distinct appearance. The term fibrous is used in a general mineralogical way to describe aggregates of grains that crystallize in a needle-like habit and appear to be composed of fibers. Fibrous has a much more general meaning than asbestos. While it is correct that all asbestos minerals are fibrous, not all minerals having fibrous habits are asbestos.

3.2.8 *indirect preparation*—a method in which a sample passes through one or more intermediate steps prior to final filtration.

3.2.9 *matrix*—a structure in which one or more fibers, or fiber bundles that are touching, are attached to, or partially concealed by a single particle or connected group of nonfibrous particles. The exposed fiber must meet the fiber definition (see 3.2.6).

3.2.10 *structures*—a term that is used to categorize all the types of asbestos particles which are recorded during the analysis (such as fibers, bundles, clusters, and matrices). Final results of the test are always expressed in asbestos structures per square centimetre.

4. Summary of Test Method

4.1 The sample is collected by vacuuming a known surface area with a standard 25 or 37 mm air sampling cassette using a plastic tube that is attached to the inlet orifice which acts as a nozzle. The sample is transferred from inside the cassette to an aqueous solution of known volume. Aliquots of the suspension are then filtered through a membrane. A section of the membrane is prepared and transferred to a TEM grid using the direct transfer method. The asbestiform structures are identified, sized, and counted by TEM, using SAED and EDXA at a magnification of 15 000 to 20 000X.

5. Significance and Use

5.1 This microvacuum sampling and indirect analysis method is used for the general testing of non-airborne dust samples for asbestos. It is used to assist in the evaluation of dust that may be found on surfaces in buildings such as ceiling tiles, shelving, electrical components, duct work, carpet, etc. This test method provides an index of the concentration of asbestos structures in the dust per unit area analyzed as derived from a quantitative TEM analysis.

5.1.1 This test method does not describe procedures or techniques required to evaluate the safety or habitability of buildings with asbestos-containing materials, or compliance with federal, state, or local regulations or statutes. It is the user's responsibility to make these determinations.

5.1.2 At present, a single direct relationship between asbestos-containing dust and potential human exposure does not exist. Accordingly, the user should consider these data in relationship to other available information in their evaluation.

5.2 This test method uses the definition, settleable particulate material, found in Test Method D 1739 as the definition of dust. This definition accepts all particles small enough to pass through a 1 mm (No. 18) screen. Thus, a single, large asbestos containing particle(s) (from the large end of the particle size distribution) dispersed during sample preparation may result in anomalously large asbestos concentration results in the TEM analyses of that sample. It is, therefore, recommended that multiple independent samples are secured from the same area, and a minimum of three samples analyzed by the entire procedure.

6. Interferences

6.1 The following minerals have properties (that is, chemical or crystalline structure) which are very similar to asbestos minerals and may interfere with the analysis by causing a false positive to be recorded during the test. Therefore, literature references for these materials must be maintained in the laboratory for comparison to asbestos minerals so that they are not misidentified as asbestos minerals.

6.1.1 *Antigorite.*

6.1.2 *Palygorskite (Attapulgite).*

6.1.3 *Halloysite.*

6.1.4 *Pyroxenes.*

6.1.5 *Sepiolite.*

6.1.6 *Vermiculite scrolls.*

6.1.7 *Fibrous talc.*

6.1.8 Hornblende and other amphiboles other than those listed in 3.1.2.

6.2 Collecting any dust particles greater than 1 mm in size in this test method may cause an interference and, therefore, must be avoided.

7. Materials and Equipment

7.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without

lessening the accuracy of the determination.[6]

7.2 *Transmission Electron Microscope (TEM)*, an 80 to 120 kV TEM, capable of performing electron diffraction, with a fluorescent screen inscribed with calibrated gradations, is required. The TEM must be equipped with energy dispersive X-ray spectroscopy (EDXA) and it must have a scanning transmission electron microscopy (STEM) attachment or be capable of producing a spot size of less than 250 nm in diameter in crossover.

7.3 *Energy Dispersive X-ray System (EDXA).*

7.4 *High Vacuum Carbon Evaporator*, with rotating stage.

7.5 *High Efficiency Particulate Air (HEPA)*, filtered negative flow hood.

7.6 *Exhaust or Fume Hood.*

7.7 *Particle-free Water* (ASTM Type II, see Specification D 1193).

7.8 *Glass Beakers* (50 mL).

7.9 *Glass Sample Containers*, with wide mouth screw cap (200 mL) or equivalent sealable container (height of the glass sample container should be approximately 13 cm high by 6 cm wide).

7.10 *Waterproof Markers.*

7.11 *Forceps* (tweezers).

7.12 *Ultrasonic Bath*, table top model (100 W).

7.13 *Graduated Pipettes* (1, 5, 10 mL sizes), glass or plastic.

7.14 *Filter Funnel*, either 25 mm or 47 mm, glass or disposable. Filter funnel assemblies, either glass or disposable plastic, and using either a 25 mm or 47 mm diameter filter.

7.15 *Side Arm Filter Flask*, 1000 mL.

7.16 *Mixed Cellulose Ester (MCE) Membrane Filters*, 25 or 47 mm diameter, ≤0.22 µm and 5 µm pore size.

7.17 *Polycarbonate (PC) Filters*, 25 or 47 mm diameter, ≤0.2 µm pore size.

7.18 *Storage Containers*, for the 25 or 47 mm filters (for archiving).

7.19 *Glass Slides*, approximately 76 by 25 mm in size.

7.20 *Scalpel Blades*, No. 10, or equivalent.

7.21 *Cabinet-type Desiccator*, or low temperature drying oven.

7.22 *Chloroform*, reagent grade.

7.23 *Acetone*, reagent grade.

7.24 *Dimethylformamide (DMF).*

7.25 *Glacial Acetic Acid.*

7.26 *1-methyl-2-pyrrolidone.*

7.27 *Plasma Asher*, low temperature.

7.28 *pH Paper.*

7.29 *Air Sampling Pump*, low volume personal-type, capable of achieving a flow rate of 1 to 5 L/min.

7.30 *Rotameter.*

7.31 *Air Sampling Cassettes*, 25 mm or 37 mm, containing 0.8 µm or smaller pore size MCE or PC filters.

7.32 *Cork Borer*, 7 mm.

7.33 *Non-Asbestos Mineral*, references as outlined in 6.1.

7.34 *Asbestos Standards*, as outlined in 3.1.2.

7.35 *Tygon*[7] *Tubing*, or equivalent.

7.36 *Small Vacuum Pump*, that can maintain a pressure of 92 kPa.

7.37 *Petri Dishes*, large glass, approximately 90 mm in diameter.

7.38 *Jaffe Washer*, stainless steel or aluminum mesh screen, 30 to 40 mesh, and approximately 75 mm by 50 mm in size.

7.39 *Copper TEM Finder Grids*, 200 mesh.

7.40 *Carbon Evaporator Rods.*

7.41 *Lens Tissue.*

7.42 *Ashless Filter Paper Filters*, 90 mm diameter.

7.43 *Gummed Paper Reinforcement Rings.*

7.44 *Wash Bottles*, plastic.

7.45 *Reagent Alcohol*, HPLC Grade (Fisher A995 or equivalent).

7.46 *Opening Mesh Screen*, plastic, 1.0 by 1.0 mm, (Spectra-Mesh #146410 or equivalent).

7.47 *Diffraction Grating Replica.*

8. Sampling Procedure for Microvacuum Technique

8.1 For sampling asbestos-containing dust in either indoor or outdoor environments, commercially available cassettes must be used. Air monitoring cassettes containing 25 mm or 37 mm diameter mixed cellulose ester (MCE) or polycarbonate (PC) filter membranes with a pore size less than or equal to 0.8 µm are required (7.31). The number of samples collected depends upon the specific circumstances of the study.

8.2 Maintain a log of all pertinent sampling information and sampling locations.

8.3 Sampling pumps and flow indicators shall be calibrated using a certified standard apparatus or assembly (see Practice D 3195 and 7.29).

8.4 Record all calibration information (5).

8.5 Perform a leak check of the sampling system at each sampling site by activating the pump (7.29) with the closed sampling cassette in line. Any air flow shows that a leak is present that must be eliminated before initiating the sampling operation.

8.6 Attach the sampling cassette to the sampling pump at the outlet side of the cassette with plastic tubing (7.35). The plastic tubing must be long enough in that the sample areas can be reached without interference from the sampling pump. Attach a clean, approximately 25.4 mm long piece of plastic tubing (6.35 mm internal diameter) directly to the inlet orifice. Use this piece of tubing as the sampling nozzle. Cut the sampling end of the tubing at a 45° angle as illustrated in Fig. 1. The exact design of the nozzle is not critical as long as some vacuum break is provided to avoid simply pushing the dust around on the surface with the nozzle rather than vacuuming it into the cassette. The internal diameter of the nozzle and flow rate of the pump may vary as long as the air velocity is 100 (±10) cm/s. This air velocity calculation is based on an internal sampling tube diameter of 6.35 mm at a flow rate of 2 L/min.

8.7 Measure and determine the sample area of interest. A

[6] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.

[7] Tygon is a registered trademark of the DuPont Co.

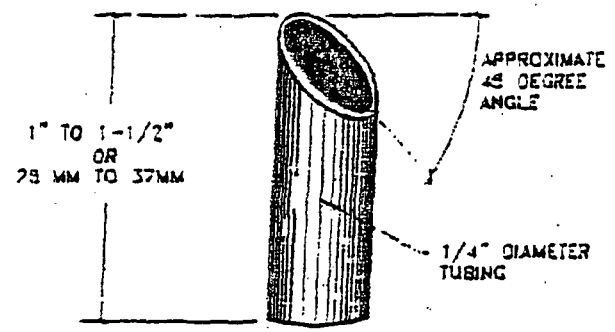


FIG. 1 Example of the Tubing Nozzle

sample area of 100 cm^2 is vacuumed until there is no visible dust or particulates matter remaining. Perform a minimum of two orthogonal passes on the surface within a minimum of 2 min of sampling time. Avoid scraping or abrading the surface being sampled. (Do not sample any debris or dust particles greater than 1 mm in diameter (see 4.2).) Smaller or larger areas can be sampled, if needed. For example, some surfaces of interest may have a smaller area than 100 cm^2. Less dusty surfaces may require vacuuming of larger areas. Unlike air samples, the overloading of the cassettes with dust will not be a problem. As defined in 3.2.5, only dust shall be collected for this analysis.

8.8 At the end of sample collection, invert the cassette so that the nozzle inlet faces up before shutting off the power to the pump. The nozzle is then sealed with a cassette end-plug and the cassette/nozzle taped or appropriately packaged to prevent separation of the nozzle and cassette assembly. A second option is the removal of the nozzle from the cassette, then plugging of the cassette and shipment of the nozzle (also plugged at both ends) sealed in a separate closeable plastic bag. A third option is placing the nozzle inside the cassette for shipment. The nozzle is always saved and rinsed because a significant percentage of the dust drawn from a lightly loaded surface may adhere to the inside walls of the tubing.

8.9 Check that all samples are clearly labeled, that all dust sampling information sheets are completed, and that all pertinent information has been enclosed, in accordance with laboratory quality control practices, before transfer of the samples to the laboratory. Include an unused cassette and nozzle as a field blank.

8.10 Wipe off the exterior surface of the cassettes with disposable wet towels (baby wipes) prior to packaging for shipment.

9. Sample Shipment

9.1 Ship dust samples to an analytical laboratory in a sealed container, but separate from any bulk or air samples. The cassettes must be tightly sealed and packed in a material free of fibers or dust to minimize the potential for contamination. Plastic "bubble pack" is probably the most appropriate material for this purpose.

10. Sample Preparation

10.1 Under a negative flow HEPA hood (7.5), carefully wet-wipe the exterior of the cassettes to remove any possible contamination before taking cassettes into a clean preparation area.

10.2 Perform sample preparation in a clean facility that has a separate work area from both the bulk and air sample preparation areas.

10.3 Initial specimen preparation shall take place in a clean HEPA filtered negative pressure hood to avoid any possible contamination of the laboratory or personnel, or both, by the potentially large number of asbestos structures in an asbestos-containing dust sample. Cleanliness of the preparation area hoods is measured by the cumulative process blank concentrations (see Section 11).

10.4 All sample preparation steps 10.4.1 through 10.4.5 shall take place in the dust preparation area inside a HEPA hood.

10.4.1 Remove the upper plug from the sample cassette and carefully introduce approximately 10 mL solution of a 50/50 mixture of particle-free water and reagent alcohol into the cassette using a plastic wash bottle (7.44). If the plugged nozzle was left attached to the cassette, then remove the plug and introduce the water/alcohol solution into the cassette through the tubing, and then remove the tubing, if it is visibly clean.

10.4.2 Replace the upper plug or the sample cap and lightly shake the dust suspension by hand for 3 s.

10.4.3 Remove the entire cap of the cassette and pour the suspension through a 1.0 by 1.0 mm opening screen (7.46) into a pre-cleaned 200 mL glass specimen bottle (7.9). All visible traces of the sample contained in the cassette shall be rinsed through the screen into the specimen bottle with a plastic wash bottle containing the 50/50 solution of particle-free water and alcohol. Repeat this procedure two additional times for a total of three washings. Next, rinse the nozzle two or three times through the screen into the specimen bottle with the 50/50 mixture of water and alcohol. Typically, the total amount of the 50/50 mixture used in the rinse is 50 to 75 mL. Discard the 1.0 by 1.0 mm screen and bring the volume of solution in the specimen bottle up to the 100 mL mark on the side of the bottle with particle-free water only.

10.4.4 Adjust the pH of the suspension to 3 to 4 using a 10.0 % solution of acetic acid. Use pH paper for testing. Filter the suspension within 24 h to avoid problems associated with bacterial and fungal growth.

10.4.5 Use either a disposable plastic filtration unit or a glass filtering unit (7.14) for filtration of aliquots of the suspension. The ability of an individual filtration unit to produce a uniform distribution may be tested by the filtration of a colored particulate suspension such as diluted India ink (suspension of carbon black).

10.4.5.1 If a disposable plastic filtration unit is used, then unwrap a new disposable plastic filter funnel unit (either 25 or 47 mm diameter) and remove the tape around the base of the funnel. Remove the funnel and discard the top filter supplied with the apparatus, retaining the coarse polypropylene support pad in place. Assemble the unit with the adapter and a properly sized neoprene stopper, and attach the funnel to the 1000 mL side-arm vacuum flask (7.15). Place a 5.0 µm pore size MCE (backing filter) on the support pad. Wet it with a few mL of particle-free water and place an MCE (7.16) or PC filter (≤0.22 µm pore size) (7.17) on top of the backing filter. Apply a vacuum (7.36), ensuring

that the filters are centered and pulled flat without air bubbles. Any irregularities on the filter surface requires the discard of that filter. After the filter has been seated properly, replace the funnel and reseal it with the tape. Return the flask to atmospheric pressure.

10.4.5.2 If a glass filtration unit is used, place a 5 µm pore size MCE (backing filter) on the glass frit surface. Wet the filter with particle-free water, and place an MCE or PC filter (≤0.22 µm pore size) on top of the backing filter. Apply a vacuum, ensuring that the filters are centered and pulled flat without air bubbles. Replace the filters if any irregularities are seen on the filter surface. Before filtration of each set of sample aliquots, prepare a blank filter by filtration of 50 mL of particle-free water. If aliquots of the same sample are filtered in order of increasing concentration, the glass filtration unit need not be washed between filtration. After completion of the filtration, do not allow the filtration funnel assembly to dry because contamination is then more difficult to remove. Wash any residual suspension from the filtration assembly by holding it under a flow of water, then rub the surface with a clean paper towel soaked in a detergent solution. Repeat the cleaning operation, and then rinse two times in particle-free water.

10.4.6 With the flask at atmospheric pressure, add 20 mL of particle-free water into the funnel. Cover the filter funnel with its plastic cover if the disposable filtering unit is used.

10.4.7 Briefly hand shake (3 s) the capped bottle with the sample suspension, then place it in a tabletop ultrasonic bath (7.12) and sonicate for 3.0 min. Maintain the water level in the sonicator at the same height as the solution in sample bottle. The ultrasonic bath shall be calibrated as described in 20.5. The ultrasonic bath must be operated at equilibrium temperature. After sonicating, return the sample bottle to the work surface of the HEPA hood. Preparation steps 10.4.8 through 10.4.14 shall be carried out in this hood.

10.4.8 Shake the suspension lightly by hand for 3 s, then let it rest for 2.0 min to allow large particles to settle to the bottom of the bottle or float to the surface.

10.4.9 Estimate the amount of liquid to be withdrawn to produce an adequate filter preparation. Experience has shown that a light staining of the filter surface will yield a suitable preparation for analysis. Filter at least 1.0 mL, but no more than half the total volume. If after examination in the TEM, the smallest volume measured (1.0 mL) (7.13) yields an overloaded sample, then perform additional serial dilutions of the suspension. If it is estimated that less than 1.0 mL of solution has to be filtered because of the density of the suspension, perform a serial dilution.

10.4.9.1 If serial dilutions are required, repeat step 10.4.8 before the serial dilution portion is taken. Do not re-sonicate the original solution or any serial dilutions. The recommended procedure for a serial dilution is to mix 10 mL of the sample solution with 90 mL of particle-free water in a clean sample bottle to obtain a 1:10 serial dilution. Follow good laboratory practices when performing dilutions.

10.4.10 Insert a new disposable pipette halfway into the sample suspension and withdraw a portion. Avoid pipetting any of the large floating or settled particles. Uncover the filter funnel and dispense the mixture from the pipette into the water in the funnel.

10.4.11 Apply vacuum to the flask and draw the mixture through the filter.

10.4.12 Discard the pipette.

10.4.13 Disassemble the filtering unit and carefully remove the sample filter with fine tweezers (7.11). Place the completed sample filter particle side up, into a precleaned, labeled, disposable, plastic petri dish (7.48) or other similar container.

10.4.14 In order to ensure that an optimally-loaded filter is obtained, it is recommended that filters be prepared from several different aliquots of the dust suspension. For this series of filters, it is recommended that the volume of each aliquot of the original suspension be a factor of five higher than the previous one. If the filters are prepared in order of increasing aliquot volume, all of the filters for one sample can be prepared using one plastic disposable filtration unit, or without cleaning of glass filtration equipment between individual filtration. Before withdrawal of each aliquot from the sample, shake the suspension without additional sonification and allow to rest for 2 min.

10.4.15 There are many practical methods for drying MCE filters. The following are two examples that can be used: (1) dry MCE filters for at least 12 h (over desiccant) in an airtight cabinet-type desiccator (7.21); (2) to shorten the drying time (if desired), remove a plug of the damp filter and attach it to a glass slide (7.19) as described in 12.1.2 and 12.1.3. Place the slide with a filter plug or filter plugs (up to eight plugs can be attached to one slide) on a bed of desiccant, in the desiccator for 1 h.

10.4.16 PC filters do not require lengthy drying before preparation, but shall be placed in a desiccator for at least 30 min before preparation.

10.5 Prepare TEM specimens from small sections of each dried filter using the appropriate direct transfer preparation method.

11. Blanks

11.1 Prepare sample blanks that include both a process blank (50 mL of particle-free water) for each set of samples analyzed and one unused filter from each new box of sample filters (MCE or PC) used in the laboratory. If glass filtering units are used, prepare and analyze a process blank each time the filtering unit is cleaned. Blanks will be considered contaminated, if after analysis, they are shown to contain more than 53 asbestos structures per square millimetre. This generally corresponds to three or four asbestos structures found in ten grid openings. The source of the contamination must be found before any further analysis can be performed. Reject samples that were processed along with the contaminated blanks and prepare new samples after the source of the contamination is found.

11.2 Prepare field blanks which are included with sample sets in the same manner as the samples, to test for contamination during the sampling, shipping, handling, and preparation steps of the method.

12. TEM Specimen Preparation of Mixed Cellulose Ester (MCE) Filters

NOTE 1—Use of either the acetone or the dimethylformamide-acetic acid method is acceptable.

12.1 *Acetone Fusing Method:*

12.1.1 Remove a section (a plug) from any quadrant of the sample and blank filters. Sections can be removed from the filters using a 7 mm cork borer (7.32). The cork borer must be wet wiped after each time a section is removed.

12.1.2 Place the filter section (particle side up) on a clean microscope slide. Affix the filter section to the slide with a gummed page reinforcement (7.43), or other suitable means. Label the slide with a glass scribing tool or permanent marker (7.10).

12.1.3 Prepare a fusing dish from a glass petri dish (7.37) and a metal screen bridge (7.38) with a pad of five to six ashless paper filters (7.42) and place in the bottom of the petri dish (4). Place the screen bridge on top of the pad and saturate the filter pads with acetone. Place the slide on top of the bridge in the petri dish and cover the dish. Wait approximately 5 min for the sample filter to fuse and clear.

12.2 *Dimethylformamide-Acetic Acid Method:*

12.2.1 Place a drop of clearing solution that consists of 35 % dimethylformamide (DMF), 15 % glacial acetic acid, and 50 % Type II water (v/v) on a clean microscope slide. Gauge the amount used so that the clearing solution just saturates the filter section.

12.2.2 Carefully lay the filter segment, sample surface upward, on top of the solution. Bring the filter and solution together at an angle of about 20° to help exclude air bubbles. Remove any excess clearing solution. Place the slide in an oven or on a hot plate, in a fume hood, at 65 to 70°C for 10 min.

12.3 Plasma etching of the collapsed filter is required.

12.3.1 The microscope slide to which the collapsed filter pieces are attached is placed in a plasma asher (7.27). Because plasma ashers vary greatly in their performance, both from unit to unit and between different positions in the asher chamber, it is difficult to specify the exact conditions that must be used. Insufficient etching will result in a failure to expose embedded fibers, and too much etching may result in the loss of particles from the filter surface. To determine the optimum time for ashing, place an unused 25 mm diameter MCE filter in the center of a glass microscope slide. Position the slide approximately in the center of the asher chamber. Close the chamber and evacuate to a pressure of approximately 40 Pa, while admitting oxygen to the chamber at a rate of 8 to 20 cm^3/min. Adjust the tuning of the system so that the intensity of the plasma is maximized. Determine the time required for complete oxidation of the filter. Adjust the system parameters to achieve complete oxidation of the filter in a period of approximately 15 min. For etching of collapsed filters, use these operating parameters for a period of 8 min. For additional information on calibration, see the *USEPA Asbestos-Containing Materials in Schools* (4) or *NIST/NVLAP Program Handbook for Airborne Asbestos Analysis* (6) documents.

12.3.2 Place the glass slide containing the collapsed filters into the low-temperature plasma asher, and etch the filter.

12.4 Carbon coating of the collapsed and etched filters is required.

12.4.1 Carbon coating must be performed with a high-vacuum coating unit (7.4), capable of less than 10^{-4} torr (13 MPa) pressure. Units that are based on evaporation of carbon filaments in a vacuum generated only by an oil rotary pump have not been evaluated for this application and shall not be used. Carbon rods (7.40) used for evaporators shall be sharpened with a carbon rod sharpener to a neck of about 4 mm in length and 1 mm in diameter. The rods are installed in the evaporator in such a manner that the points are approximately 100 to 120 mm from the surface of the microscope slide held in the rotating device.

12.4.2 Place the glass slide holding the filters on the rotation device, and evacuate the evaporator chamber to a vacuum of at least 13 MPa. Perform the evaporation in very short bursts, separated by 3 to 4 s to allow the electrodes to cool. An alternate method of evaporation is by using a slow continuous applied current. An experienced analyst can judge the thickness of the carbon film to be applied. Conduct tests on unused filters first. If the carbon film is too thin, large particles will be lost from the TEM specimen, and there will be few complete and undamaged grid openings on the specimen.

12.4.2.1 If the coating is too thick, it will lead to a TEM image that is lacking in contrast, and the ability to obtain electron diffraction patterns will be compromised. The carbon film shall be as thin as possible and still remain intact on most of the grid openings of the TEM specimen.

12.5 *Preparation of the Jaffe Washer*—The precise design of the Jaffe washer is not considered important, so any one of the published designs may be used (7, 8). One such washer consists of a simple stainless steel bridge contained in a glass petri dish.

12.5.1 Place several pieces of lens tissue (7.41) on the stainless steel bridge. The pieces of lens tissue shall be large enough to completely drape over the bridge and into the solvent. In a fume hood, fill the petri dish with acetone (or DMF) until the height of the solvent is brought up to contact the underside of the metal bridge as illustrated in Fig. 2.

12.6 *Placing the Specimens into the Jaffe Washer:*

12.6.1 Place the TEM grids (7.39) shiny side up on a piece of lens tissue or filter paper so that individual grids can be easily picked up with tweezers.

12.6.2 Prepare three grids from each sample.

12.6.2.1 Using a curved scalpel blade (7.20), excise at least two square (3 mm by 3 mm) pieces of the carbon-coated MCE filter from the glass slide.

12.6.2.2 Place the square filter piece carbon-side up on top of a TEM specimen grid.

12.6.2.3 Place the whole assembly (filter/grid) on the saturated lens tissue in the Jaffe washer.

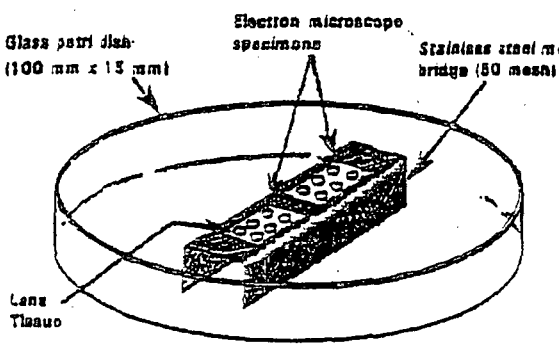


FIG. 2 Example of Design of Solvent Washer (Jaffe Washer)

12.6.2.4 Place the three TEM grid sample filter preparations on the same piece of lens tissue in the Jaffe washer.

12.6.2.5 Place the lid on the Jaffe washer and allow the system to stand for several hours.

12.7 Alternately, place the grids on a low level (petri dish filled to the ½ mark) DMF Jaffe washer for 60 min. Add enough solution of equal parts DMF/acetone to fill the washer to the screen level. Remove the grids after 30 min if they have cleared, that is, all filter material has been removed from the carbon film, as determined by inspection in the TEM.

12.8 Carefully remove the grids from the Jaffe washer, allowing the grids to dry before placing them in a clean marked grid box.

13. TEM Specimen Preparation of Polycarbonate (PC) Filter

13.1 Cover the surface of a clean microscope slide with two strips of double-sided adhesive tape.

13.2 Cut a strip of filter paper slightly narrower than the width of the slide. Position the filter paper strip on the center of the length of the slide.

13.3 Using a clean, curved scalpel blade, cut a strip of the PC filter approximately 25 by 6 mm. Use a rocking motion of the scalpel blade to avoid tearing the filter. Place the PC strip particle side up on the slide perpendicular to the long axis of the slide. The ends of the PC strip must contact the double sided adhesive tape. Each slide can hold several PC strips. With a glass marker, label each PC strip with the individual sample number.

13.4 Carbon coat the PC filter strips as discussed in 12.4.2. PC filters do not require etching.

NOTE 2: Caution—Do not overheat the filter sections while carbon coating.

13.5 Prepare a Jaffe washer as described in 12.5, but fill the washer with chloroform or 1-methyl-2-pyrrolidone to the level of the screen.

13.6 Using a clean curved scalpel blade, excise three, 3-mm square filter pieces from each PC strip. Place the filter squares carbon side up on the shiny side of a TEM grid. Pick up the grid and filter section together and place them on the lens tissue in the Jaffe washer.

13.7 Place the lid on the Jaffe washer and rest the grids in place for at least 4 h. Best results are obtained with longer wicking times, up to 12 h.

13.8 Carefully remove the grids from the Jaffe washer, allowing the grids to dry before placing them in a clean, marked grid box.

14. Grid Opening Measurements

14.1 TEM grids must have a known grid opening area. Determine this area as follows:

14.2 Measure at least 20 grid openings in each of 20 random 75 to 100 μm (200-mesh) copper grids for a total of 400 grid openings for every 1000 grids used, by placing the 20 grids on a glass slide and examining them under the optical microscope. Use a calibrated graticule to measure the average length and width of the 20 openings from each of the individual grids. From the accumulated data, calculate the average grid opening area of the 400 openings.

14.3 Grid area measurements can also be made at the TEM at a calibrated screen magnification of between 15 000 and 20 000X. Typically measure one grid opening for each grid examined. Measure grid openings in both the x and y directions and calculate the area.

14.4 Pre-calibrated TEM grids are also acceptable for this test method.

15. TEM Method

15.1 Microscope settings: 80 to 120 kV, 15 000 to 20 000X screen magnification for analysis (7.2).

15.2 Analyze two grids for each sample. Analyze one-half of the sample area on one sample grid preparation and the remaining half on a second sample grid preparation.

15.3 *Determination of Specimen Suitability:*

15.3.1 Carefully load the TEM grid, carbon side facing up (in the TEM column) with the grid bars oriented parallel/perpendicular to the length of the specimen holder. Use a hand lens or loupe, if necessary. This procedure will line up the grid with the X and y translation directions of the microscope. Insert the specimen holder into the microscope.

15.3.2 Scan the entire grid at low magnification (250X to 1000X) to determine its suitability for high magnification analysis as specified in 15.3.3.

15.3.3 Grids are acceptable for analysis if the following conditions are met:

15.3.3.1 The fraction of grid openings covered by the replica section is at least 50 %.

15.3.3.2 Relative to that section of the grid covered by the carbon replica, the fraction of intact grid openings is greater than 50 %.

15.3.3.3 The fractional area of undissolved filter is less than 10 %.

15.3.3.4 The fraction of grid openings with overlapping or folded replica film is less than 50 %.

15.3.3.5 At least 20 grid openings, that have no overlapping or folded replica, are less than 5 % covered with holes and have less than 5 % opaque area due to incomplete filter dissolution.

15.4 *Determination of Grid Opening Suitability:*

15.4.1 If the grid meets acceptance criteria, choose a grid opening for analysis from various areas of the grid so that the entire grid is represented. Determine the suitability of each individual grid opening prior to the analysis.

15.4.2 The individual grid opening must have less than 5 % holes over its area.

15.4.3 Grid openings must be less than 25 % covered with particulate matter.

15.4.4 Grid openings must be uniformly loaded.

15.5 Observe and record the orientation of the grid at 80 to 150X, on a grid map record sheet along with the location of the grid openings that are examined for the analysis. If indexed grids are used, a grid map is not required, but the identifying coordinates of the grid square must be recorded.

16. Recording Data Rules

16.1 Record on the count sheet any continuous grouping of particles in which an asbestos fiber is detected. Classify asbestos structures as fibers, bundles, clusters, or matrices as defined in 5.2.

16.2 Use the criteria for fiber, bundle, cluster, and matrix identification, as described in the *USEPA Asbestos-Containing*

Materials in Schools document (4). Record, for each AHERA structure identified, the length and width measurements.

16.3 Record NSD (No Structures Detected) when no structures are detected in the grid opening.

16.4 Identify structures classified as chrysotile identified by either electron diffraction or X-ray analysis (7.3) and recorded on a count sheet. Verify at least one out of every ten chrysotile structures by X-ray analysis.

16.5 Structures classified as amphiboles by X-ray analysis and electron diffraction are recorded on the count sheet. For more information on identification, see Yamate, et al, (7) or Chatfield and Dillon (8).

16.6 Record a typical electron diffraction pattern for each type of asbestos observed for each group of samples (or a minimum of every five samples) analyzed. Record the micrograph number on the count sheet. Record at least one X-ray spectrum for each type of asbestos observed per sample. Attach the print-outs to the back of the count sheet. If the X-ray spectrum is stored, record the file and disk number on the count sheet.

16.7 *Counting Rules:*

16.7.1 At a screen magnification of between 15 000 and 20 000X evaluate the grids for the most concentrated sample loading; reject the sample if it is estimated to contain more than 50 asbestos structures per grid opening. Proceed to the next lower concentrated sample until a set of grids are obtained that have less than 30 asbestos structures per grid opening.

16.8 *Analytical Sensitivity*—An analytical sensitivity of approximately 1000 asbestos structures per square centimetre (calculated for the detection of a single asbestos structure) has been designed for this analysis. This sensitivity can be achieved by increasing the amount of liquid filtered, increasing the number of grid openings analyzed, or decreasing the size of the final filter. Occasionally, due to high particle loadings or high asbestos concentration, this analytical sensitivity cannot be practically achieved and stopping rules apply.

16.9 *Limit of Detection*—The limit of detection for this method is defined as, at a minimum, the counting of four asbestos structures during the TEM analysis. If less than four asbestos structures are counted during the analysis then the analytical result which will be reported will be less than the limit of detection and a "less than" sign (<) will appear before the number. All data shall be provided in the laboratory report.

16.10 *Stopping Rules:*

16.10.1 The analysis is stopped upon the completion of the grid square that achieves an analytical sensitivity of less than 1000 asbestos structures per square centimetre.

16.10.2 If an analytical sensitivity of 1000 asbestos structures per square centimetre cannot be achieved after analyzing ten grid openings then stop on grid opening No. 10 or the grid opening which contains the 100th asbestos structure, whichever comes first. A minimum of four grid squares shall be analyzed for each sample.

16.10.2.1 If the analysis is stopped because of the 100th structure rule, the entire grid square containing the 100th structure must be counted.

16.11 After analysis, remove the grids from the TEM, and replace them in the appropriate grid storage holder.

17. Sample Storage

17.1 The washed-out sample cassettes can be discarded after use.

17.2 Sample grids and unused filter sections (7.18) must be stored for a minimum of one year.

18. Reporting

18.1 Report the following information for each dust sample analyzed:

18.1.1 Concentration in structures/cm^2.

18.1.2 The analytical sensitivity.

18.1.3 Types of asbestos present.

18.1.4 Number of asbestos structures counted.

18.1.5 Effective filtration area.

18.1.6 Average size of the TEM grid openings that were counted.

18.1.7 Number of grid openings examined.

18.1.8 Sample dilution used.

18.1.9 Area of the surface sampled.

18.1.10 Listing of size data for each structure counted.

18.1.11 A copy of the TEM count sheet or a complete listing of the raw data. An example of a typical count sheet is shown in Appendix X1.

18.2 Determine the amount of asbestos in any accepted sample using the following formula:

$$\frac{EFA \times 100\ mL \times \#STR}{GO \times GOA \times V \times SPL} = \text{asbestos structures/cm}^2 \quad (1)$$

where:

$\#STR$ = number of asbestos structures counted,
EFA = effective filter area of the final sampling filter, mm^2,
GO = number of grid openings counted,
GOA = average grid opening area, mm^2,
SPL = surface area sampled, cm^2, and
V = volume of sample filtered in step 10.4.9, representing the actual volume taken from the original 100 mL suspension, mL.

19. Quality Control/Quality Assurance

19.1 In general, the laboratory's quality control checks are used to verify that a system is performing according to specifications regarding accuracy and consistency. In an analytical laboratory, spiked or known quantitative samples are normally used. However, due to the difficulties in preparing known quantitative asbestos samples, routine quality control testing focuses on re-analysis of samples (duplicate recounts).

19.1.1 Re-analyze samples at a rate of 1/10 of the sample sets (one out of every ten samples analyzed not including laboratory blanks). The re-analysis shall consist of a second sample preparation obtained from the final filter.

19.2 In addition, quality assurance programs must follow the criteria shown in the *USEPA Asbestos-Containing Materials in Schools* document (4) and in the *NIST/NVLAP Program Handbook for Airborne Asbestos Analysis* document (6). These documents describe sample custody, sample preparation, blank checks for contamination, calibration, sample analysis, analyst qualifications, and technical facilities.

20. Calibrations

20.1 Perform calibrations of the instrumentation on a

regular basis, and retain these records in the laboratory, in accordance with the laboratory's quality assurance program.

20.2 Record calibrations in a log book along with dates of calibration and the attached backup documentation.

20.3 A calibration list for the instrument is as follows:

20.3.1 *TEM:*

20.3.1.1 Check the alignment and the systems operation. Refer to the TEM manufacturer's operational manual for detailed instructions.

20.3.1.2 Calibrate the camera length of the TEM in electron diffraction (ED) operating mode before ED patterns of unknown samples are observed. Camera length can be measured by using a carbon coated grid on which a thin film of gold has been sputtered or evaporated. A thin film of gold is evaporated on the specimen TEM grid to obtain zone-axis ED patterns superimposed with a ring pattern from the polycrystalline gold film. In practice, it is desirable to optimize the thickness of the gold film so that only one or two sharp rings are obtained on the superimposed ED pattern. Thick gold films will tend to mask weak diffraction spots from the fibrous particles. Since the unknown d-spacings of most interest in asbestos analysis are those which lie closest to the transmitted beam, multiple gold rings from thick films are unnecessary. Alternatively, a gold standard specimen can be used to obtain an average camera constant calculated for that particular instrument and can then be used for ED patterns of unknowns taken during the corresponding period.

20.3.1.3 Perform magnification calibration at the fluorescent screen. This calibration must be performed at the magnification used for structure counting. Calibration is performed with a grating replica (7.47) (for example, one containing at least 2160 lines/mm).

(*a*) Define a field of view on the fluorescent screen. The field of view must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric).

(*b*) Frequency of calibration will depend on the service history of the particular microscope.

(*c*) Check the calibration after any maintenance of the microscope that involves adjustment of the power supply to the lens or the high voltage system or the mechanical disassembly of the electron optical column (apart from filament exchange).

(*d*) The analyst must ensure that the grating replica is placed at the same distance from the objective lens as the specimen.

(*e*) For instruments that incorporate a eucentric tilting specimen stage, all specimens and the grating replica must be placed at the eucentric position.

20.3.1.4 The smallest spot size of the TEM must be checked.

(*a*) At the crossover point, photograph the spot size at a screen magnification of 15 000 to 20 000X. An exposure time of 1 s is usually adequate.

(*b*) The measured spot size must be less than or equal to 250 nm.

20.4 *EDXA:*

20.4.1 The resolution and calibration of the EDXA must be verified.

20.4.1.1 Collect a standard EDXA Cu peak from the Cu grid.

20.4.1.2 Compare the X-ray energy versus channel number for the Cu peak and be certain that readings are within ±10 eV.

20.4.2 Collect a standard EDXA of crocidolite asbestos (NIST SRM 1866).

20.4.2.1 The elemental analysis of the crocidolite must resolve the Na peak.

20.4.3 Collect a standard EDXA of chrysotile asbestos.

20.4.3.1 The elemental analysis of chrysotile must resolve both Si and Mg on a single chrysotile fiber.

20.5 *Ultrasonic bath calibration shall be performed as follows:*

20.5.1 Fill the bath water to a level equal to the height of suspension in the glass sample container that will be used for the dust analysis. Operate the bath until the water reaches the equilibrium temperature.

20.5.2 Place 100 mL of water (at approximately 20°C) in another 200-mL glass sample container, and record its temperature.

20.5.3 Place the sample container in the water in the ultrasonic bath (with the power turned off). After 60 s, remove the glass container and record its temperature.

20.5.4 Place 100 mL of water (at approximately 20°C) in another 200-mL glass sample container, and record its temperature.

20.5.5 Place the second sample container into the water in the ultrasonic bath (with the power turned on). After 60 s, remove the glass container and record its temperature.

20.5.6 *Calculate the rate of energy deposition into the sample container using the following formula:*

$$R = 4.185 \times \sigma \times \rho \times \frac{(\theta_2 - \theta_1)}{t} \qquad (2)$$

where:

4.185 = Joules/cal,

R = energy deposition, watts/mL,

θ_1 = temperature rise with the ultrasonic bath not operating, °C,

θ_2 = temperature rise with the ultrasonic bath operating, °C,

t = time in seconds, 60 s (20.5.3 and 20.5.5),

σ = specific heat of the liquid in the glass sample container, 1.0 cal/g, and

ρ = density of the liquid in the glass sample container, 1.0 g/cm^3.

20.5.7 Adjust the operating conditions of the bath so that the rate of energy deposition is in the range of 0.08 to 0.12 MW/m^3, as defined by this procedure.

21. Precision and Bias

21.1 *Precision*—The precision of the procedure in this test method is being determined using round robin data from participating laboratories.

21.2 *Bias*—Since there is no accepted reference material suitable for determining the bias of the procedure in this test method, bias has not been determined (see Specification D 3670).

NOTE 3—Round robin data is under development and will be presented as a research report.

22. Keywords

22.1 asbestos; microvacuuming; settled dust; TEM

APPENDIX

(Nonmandatory Information)

X1. DUST SAMPLE ANALYSIS

X1.1 See Figs. X1.1 and X1.2 for the dust analysis worksheet and the TEM count sheet.

DUST SAMPLE ANALYSIS

Client: _____
Sample ID: _____
Job Number: _____
Date Sample Analyzed: - -
Number of Openings/Grids Counted: _____
Grid Accepted, 600X: Yes No
Percent Loading: _____ %
Grid Box #1: _____

Accelerating Voltage: _____
Indicated Mag: _____ KX
Screen Mag: _____ KX
Microscope: 1 2 3 4 5
Filter Type: _____
Filter Size: _____
Filter Pore Size (μm): _____
Grid Opening: 1) _____ μm x _____ μm
2) _____ μm x _____ μm

Analyst: _____

Reviewer: _____

Counting Rules: AHERA LEVEL II

Calculation Data:

Effective Filter Area in mm^2:	(EFA)	_____
Number of Grid Openings Counted:	(GO)	_____
Average Grid Opening Area in mm^2:	(GOA)	_____
Volume of sample Filtered in ml:	(V)	_____
Surface area Sampled in cm^2:	(SPL)	_____
Number of Asbestos Structures Counted:[a]	(#STR)	_____

[a] If the number of asbestos structures counted is less than or equal to 4, enter 4 structures as the limit of detection here.

FORMULA FOR CALCULATION OF ASBESTOS STRUCTURES "DUST" PER CM^2:

$$\frac{EFAX \times 100 \times \#STR}{GO \times GOA \times V \times SPL} = \text{(Asbestos Structures per } cm^2\text{)}$$

Results for Total Asbestos Structures: _____ (Structures per cm^2)

Results for Structures ≥ microns: _____ (Structures per cm^2)

FIG. X1.1 Dust Sample Analysis Work Sheet

Job Number: ______________________

Structure #	Grid # Square #	Type	Structure	Length Microns	Width Microns	Confirmation		
						Morph.	SAED	EDS

Note: Keys to Abbreviations Used in Figure:

Type:

C = Chrysotile
AM = Amosite
CR = Crocidolite
AC = Actinolite
TR = Tremolite
AN = Anthophyllite
N = Non Asbestos

Structure:

F = Fiber
B = Bundle
C = Cluster
M = Matrix

Others:

NSD = No Structures Detected
Morph = Morphology
SAED = Selected Area Electron Diffraction
EDS = Energy Dispersive X-Ray Spectroscopy
ER = Inter-Row Spacing
NP = No Pattern

FIG. X1.2 TEM Count Sheet

REFERENCES

(1) Steel, E. and Wylie, A., "Mineralogical Characteristics of Asbestos," in *Geology of Asbestos Deposits*, Riordon, P. H., Ed., SME-AIME, 1981, pp. 93–101.

(2) Zussman, J., "The Mineralogy of Asbestos," in *Asbestos: Properties, Applications and Hazards*, John Wiley and Sons, 1979, pp. 45–67.

(3) Leake, B. E., "Nomenclature of Amphiboles," *American Mineralogist*, Vol 53, 1978, pp. 1023–1052.

(4) "*USEPA Asbestos-Containing Materials in Schools: Final Rule and Notice*," *Federal Register*, 40 CFR Part 763, Appendix A to Sub-part E, Oct. 30, 1987.

(5) OSHA, *OSHA Technical Manual, OSHA Instruction CPL 2-2.20B*, Directorate of Technical Support, U.S. Department of Labor, Washington, DC 20210, Feb. 1, 1990, pp. I–3 to I–11.

(6) *NIST/NVLAP Program Handbook for Airborne Asbestos Analysis*, NISTIR, August 1989, pp. 39–4137.

(7) Yamate, G., Agarwall, S. C., and Gibbons, R. D., "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy," EPA Draft Report, Contract No. 68-02-1266, 1984.

(8) Chatfield, E. J., and Dillon, M. J., "Analytical Method for the Determination of Asbestos in Water," EPA No. 600/4-83-043, 1983.